VOLUSON® 730

INSTRUCTION MANUAL

GE Medical Systems
Kretztechnik GmbH & Co OHG

GE Medical Systems
Kretz Ultrasound

Instruction Manual

H46611E

Direction 105838

Revision 3

from Software Version Sys D03-1.07 onwards

VOLUSON® 730

CE 0366

Copyright© 2002, 2003 by GE Medical Systems – Kretztechnik GmbH & Co. OHG

Revision History

Table i-1: Reason for Change

REV	DATE	REASON FOR CHANGE
Rev.0	January 30, 2002	Software Version Sys D03-1.06
Rev.1	April 15, 2002	Software Version Sys D03-1.06F
Rev.2	October 11, 2002	Software Version Sys D03-1.06G
Rev.3	July 23, 2003	Software Version Sys D03-1.07

Table i-2: List of effective Pages

CHAPTER- / PAGE NUMBER	REV #
Cover	3
Revision History	3
Contents	3
Chapter 1 - General	3
Chapter 2 - Safety	3
Chapter 3 - Description of the System	3
Chapter 4 - Starting the System	3
Chapter 5 - Electronic User Manual (EUM)	3
Chapter 6 - Connections	3
Chapter 7 - Technical Data / Information	3

This page intentionally left blank.

REVISION HISTORY.....i-1

1. GENERAL.....1-2

2. SAFETY.....2-2

2.1 Important Instructions for Safety.....2-2

2.2 Electric installation.....2-3

2.3 Symbols used.....2-3

2.4 Remarks for safe Use.....2-5

2.5 Environmental Conditions for Operation.....2-6

2.6 Instruction for Use.....2-6

2.7 Biopsy Lines.....2-7

2.8 ECG-preamplifier (MAN).....2-7

2.9 Cleaning and Maintenance.....2-8

2.10 Safety Test.....2-8

2.11 Manufacturer Responsibility.....2-9

2.12 Service Documents.....2-9

2.13 Basic interaction between Ultrasound and Matter.....2-9

2.13.1 Bioeffects.....2-9
2.13.2 Intensities Measured in Water and recalculated In Situ.....2-11
2.13.3 Derivation and Meaning of the thermal and mechanical Indices.....2-12
2.13.4 FDA-Limits for Acoustic Output and Bioeffects.....2-15
2.13.5 Summary.....2-15
2.13.6 Display Accuracy of the Indices.....2-16
2.13.7 Recommendation to use and for the Need for following the ALARA Principle.....2-16
2.13.8 Notes for Acoustic Output Tables for Track 3.....2-17
2.13.9 Acoustic Measurement Uncertainties.....2-18
2.13.10 Acoustic Output Tables.....2-18

2.14 3D-Resolution and Sensitivity.....2-19

2.15 Measurement Accuracy of the System.....2-20

2.16 Disposal.....2-20

3. DESCRIPTION OF THE SYSTEM 3-2

3.1 Product Description 3-2
3.1.1 Biological Safety 3-3
3.1.2 Limitation Vectors 3-3
3.1.3 Bioeffects 3-4

3.2 Mechanical Design 3-4
3.2.1 System Configuration 3-4
3.2.2 Mechanical Adjustment 3-5

3.3 System Assembly 3-6
3.3.1 Basic System 3-6
3.3.2 Optional Modules 3-6
3.3.3 Optional Peripheral 3-7

3.4 Concept of Operation 3-7

3.5 Layout of menus 3-8
3.5.1 Layout of the 2D-Mode Main Menu 3-9
3.5.2 Changing of Menus 3-10
3.5.3 Position of Display Annotation 3-10
3.5.4 Control Panel 3-12

3.6 Hardkeys 3-13
3.6.1 Function of the Trackball at Diverse Dialog Pages 3-17

4 STARTING THE SYSTEM 4-2

4.1 General Remarks 4-2

4.2 Safety Warnings 4-2

4.3 Turn on Power 4-3

4.4 Transducer Connection 4-4

4.5 Probe/Program Selection 4-5
4.5.1 Starting the System 4-6
4.5.2 To freeze an Image 4-6

5 ELECTRONIC USER MANUAL (EUM) 5-2

5.1 To Exit the Electronic User Manual 5-2

5.2 Navigation Tools 5-3

5.3 Help Book - Navigation Tools 5-4

5.3.1 To View the Contents 5-4
5.3.2 To Use the Index 5-5
5.3.3 To Search for a Topic 5-6
5.3.4 To Save a Favorite Topic 5-7

6. CONNECTIONS 6-2

6.1 How to connect Auxiliary Devices safely 6-2

6.2 To Connect internal and external Accessories 6-3

6.2.1 Main Module 6-4
6.2.2 Power Supply (rear Side) 6-6
6.2.3 Power Supply (for Auxiliary Equipments) 6-7
6.2.4 Side of the Main Module-Connectors 6-8
6.2.5 Connector Panel (rear Side) 6-9
6.2.6 Color Video Monitor Connection 6-10
6.2.7 B/W Video Printer Connection Scheme 6-11
6.2.8 S-VHS Videorecorder Connection Scheme 6-12
6.2.9 Color Video Printer Connection Scheme 6-13
6.2.9.1 Sony UP-D2600S 6-13
6.2.9.2 Sony UP-D21MD 6-14
6.2.9.3 Mitsubishi CP770DW 6-15
6.2.10 Line Printer Connection Scheme 6-16
6.2.11 ECG-preamplifier (MAN 6) Connection 6-17
6.2.12 Foot Switch (MFT 7) Connection 6-18

6.3 Important Notes: Connecting Auxiliary Equipment 6-19

7. TECHNICAL DATA/INFORMATION 7-2

7.1 Power Supply 7-3

7.2 Transmitter 7-4

7.3 Receiver 7-4

7.4 Scan Converter 7-5

7.5 Cine Loop Memory 7-5

7.6 Display Modes 7-5

7.7 Signal Processing 7-6

7.8 Data Entry 7-6

7.9 Measurement and Calculation Programs 7-6

7.10 User Program Memory 7-7

7.11 Volume Scan Module 7-8

7.12 Spectral Doppler 7-9

7.13 Color Doppler 7-10

7.14 Tissue Doppler 7-11

7.15 Power Doppler 7-11

7.16 Interfaces 7-12

7.17 Monitor 7-13

7.18 External Drives 7-13

7.19 MAN ECG preamplifier 7-14

1. General.....1-2

1. General

The Voluson® 730 is a professional Diagnostic Ultrasound System which transmits Ultrasound waves into the body tissues and forms Images from the information contained within the received echoes.

The Voluson® 730 is an Active Diagnostic Medical Product belonging to Class IIa according to the MDD 93/42/EWG regulation for use on human patients.

The Voluson® 730 is developed and produced by the company Kretztechnik.
For more Information please contact:

GE Medical Systems Kretztechnik GmbH & Co OHG

Tiefenbach 15	Telephone:	+43-7682-3800-0
A-4871 Zipf	Fax.:	+43-7682-3800-47
Austria	E-mail:	kretz@med.ge.com
	Internet:	http://www.gemedical.com

2. Safety *2-2*

2.1 Important Instructions for Safety **2-2**

2.2 Electric installation **2-3**

2.3 Symbols used **2-3**

2.4 Remarks for safe Use **2-5**

2.5 Environmental Conditions for Operation **2-6**

2.6 Instruction for Use **2-6**

2.7 Biopsy Lines **2-7**

2.8 ECG-preamplifier (MAN) **2-7**

2.9 Cleaning and Maintenance **2-8**

2.10 Safety Test **2-8**

2.11 Manufacturer Responsibility **2-9**

2.12 Service Documents **2-9**

2.13 Basic interaction between Ultrasound and Matter **2-9**

2.13.1 Bioeffects 2-9
2.13.2 Intensities Measured in Water and recalculated In Situ 2-11
2.13.3 Derivation and Meaning of the thermal and mechanical Indices 2-12
2.13.4 FDA-Limits for Acoustic Output and Bioeffects 2-15
2.13.5 Summary 2-15
2.13.6 Display Accuracy of the Indices 2-16
2.13.7 Recommendation to use and for the Need for following the ALARA Principle 2-16
2.13.8 Notes for Acoustic Output Tables for Track 3 2-17
2.13.9 Acoustic Measurement Uncertainties 2-18
2.13.10 Acoustic Output Tables 2-18

2.14 3D-Resolution and Sensitivity **2-19**

2.15 Measurement Accuracy of the System **2-20**

2.16 Disposal **2-20**

2. Safety

The VOLUSON® 730 scanner system has been designed for utmost safety for patient and user. Read the following chapters thoroughly before you start working with the machine! The manufacturer guarantees safety and reliability of the system only when all the following cautions and warnings are observed.

INTENDED USE

Please note that the cautions and warnings described in this section have to be observed like Electrical Installations, Important Instructions for Safety, Environmental conditions for operation etc.
Please see section *2.1* to *2.16*
Also take care that the diagnostic possibilities of modes and the clinical applications of probes (indications for use) are known, please review Description of the System *(chapter 3)* resp. General and technical description of the concerned Probe User's manual.
For Technical Data see: *chapter 7* and Connections internal and external accessories see: *chapter 6*.

Respectively see *chapter 22* and *chapter 20* of the Basic User Manual for Voluson® 730.

FEDERAL LAW RESTRICTS THIS DEVICE TO SALE BY OR ON THE ORDER OF A PHYSICIAN

WARNING: describes precautions necessary to prevent risks of live.

CAUTION: describes precautions necessary to protect the equipment.

CAUTION: The manual refers to probes that can be connected to the device. It might be possible that some probes are NOT available in some countries!!

CAUTION: Some features and options are not available in some countries!!

2.1 Important Instructions for Safety

WARNING ! This equipment must not be used in the presence of inflammable gases (e.g. anesthetic gases) => explosion hazard!

WARNING ! The system must only be connected to a fully intact mains socket with a grounded guard wire via an appropriate mains cable. The ground wire must never be removed or disconnected.

WARNING ! No covers or panels must be removed from the system (high-voltage risk). GE Medical Systems-authorized personal must only perform Service and repairs. Attempting do-it-yourself repairs invalidate warranty and are an infringement to regulations and are inadmissible acc. to IEC 60601-1.

Under the condition of regular maintenance by the authorized service personal a lifetime of the equipment of 10 years may be expected.

WARNING ! Only accessories explicitly recognized by the system manufacturer GE Medical Systems Kretztechnik GmbH & Co.OHG may be used in connection with the system.

WARNING ! The footswitch must not be used in operating rooms!

WARNING !

There have been reports of severe allergic reactions to medical devices containing latex (natural rubber). Operators are advised to identify latex-sensitive patients and be prepared to treat allergic reactions promptly.
Refer to FDA Medical Alert MDA91-1

2.2 Electric installation

The system must be exclusively installed in medically used rooms. The equipment conforms with regulations for electrical safety (EN60.601-1/1990 resp. ÖVE-MG/EN60.601-1/1991 and IEC 60601) and safety class IIa according to the MDD 93/42/EWG regulation for use on humans patients. Probes are rated Type BF. Local safety regulations may require an additional connection between the potential equilibrium bolt and the building's grounding system.

CAUTION ! Before switching on the first time, the local mains voltage and frequency are to be checked against the values indicated on the VOLUSON® 730 nameplate on the rear panel. Authorized personnel must only perform any change to the system.

The minimum required house installation must have 16A.

2.3 Symbols used

Some symbols used with electrical medical equipment have been accepted as standard by IEC. They serve for marking of connection, accessories, and as warnings.

Mains switch ON acc. to IEC 417 5007

Mains switch OFF acc. to IEC 417 5008

Standby switch of the System. Location see: System Configuration acc. to IEC 417 5009

ON switch of the isolation transformer for auxiliary devices acc. to IEC 417 5264

OFF switch of the isolation transformer for auxiliary devices acc. to IEC 417 5265

CAUTION! Review user manual for proper operation!
(Improper use may cause damage.)

Insulated patient application part acc. to EN60 601-1(Type BF)

IPX1 Protection against dripping water.

IPX7 Protection against the effects of immersion.

Potential equilibrium connection (rear panel)

Dangerous electric voltage
Pull the mains plug before opening the unit!

2.4 Remarks for safe Use

- Get acquainted with the transducers and the ultrasound system: read the user manual thoroughly!
- Follow these safety instructions as well as the clinically adopted precautions and measures for hygiene.
- The manufacturer is not liable for damage caused by improper or inexpert use of the device!
- Any ultrasound transducers - irrespective of system and design - are sensitive to shock and shall be treated with care. Pay attention to cracks which may allow conductive fluids to leak in.
- Authorized personnel shall only perform any type of repair. Never attempt to open a transducer or transducer connector. This leads to a loss of guarantee!
- Avoid kinking, bending or twisting of probe cables and take care to guard them against mechanical stress (e.g., wheels or heels).
- The probes must not be exposed to mechanical shock (e.g., by dropping).
  Any damage caused in this manner invalidates warranty.
- Have the scanner system and the transducers regularly checked (for faulty cables, housing, etc.) by authorized personnel!
- Damage to transducer or cable may lead to a safety hazard, therefore have them repaired immediately!
- Before plugging in or unplugging a transducer, activate the "FREEZE" mode!
- A specialist acquainted with the handling and use of the system shall perform installation and first switch-on and check-up of the system.
- The user must have read and understood the user manual.
  The system must only be operated by trained and qualified personnel.
- For safety reasons, avoid handling fluids in the vicinity of the system. Fluids leaking into the disk drive can damage the drive. Never remove the storage shelf above the probe connectors; it helps to protect the unit from fluids.
- Do not put your hand under the control console when moving it: Danger of injuries!
- Trolley: never move the unit with blocked wheels, but block the wheels in the proximity of stairs and ramps.
- Place the unit always on horizontal ground and block the front wheels: Danger of tipping over and rolling away.
- In transporting the unit, raise the footrest: Danger of injuries!
- The user manual must always be with the scanner system. It is the user's duty to ensure this!
- Only probes conforming to type BF requirements may be used with the VOLUSON® 730.

See the probe's label. In case of doubt ask authorized service personnel.

- The Voluson® 730 system has been tested for EMC and is compliance with EN 55011:1991 group 1 class A (CISPR 11:1997 amendment 1:1999) and EN 60601-1-2:1993. The Voluson® 730 system is approved for use in a residential district. It is expected that the user has medical experience and is well informed with the user manual.

- Mains power quality should be that of a typical commercial and/or hospital environment. If the user requires continued operation during power mains interruptions, it is recommended that the system be powered from an uninterruptable power source (UPS).

  There have been reports of severe allergic reactions to medical devices containing latex (natural rubber). Operators are advised to identify latex-sensitive patients and be prepared to treat allergic reactions promptly. Refer to FDA Medical Alert MDA91-1.

2.5 Environmental Conditions for Operation

Temperature:	10°C to 40°C resp. 50°F to 104°F
Humidity:	30% to 80% RH, no condensation
Barometric pressure:	700 to 1060 hPa

CAUTION ! Do not operate the system in the vicinity of a source of heat, of strong electric or magnetic fields (close to a transformer), or near instruments generating high-frequency signals, such as HF surgery.
These can affect the ultrasound images adversely.

CAUTION ! In the event the equipment has been brought from cold environment (stock room, airfreight) into a warm room, allow several hours for temperature balance and passing of condensation humidity before switching on the first time.

2.6 Instruction for Use

This equipment has been tested and found to comply with the limits for medical devices in IEC 60601-1-2:1994. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other devices in the vicinity. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to other devices, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving device.
- Increase the separation between the equipments.
- Connect the equipment to an outlet on a circuit different from that to which the other device(s) are connected.
- Consult the manufacturer or field service technician for help.

2.7 Biopsy Lines

To achieve best possible accuracy of the display of the needle way, the biopsy lines have to be programmed for each transducer.
review: To program a Biopsy Line *(chapter 19.1)* of the Basic User Manual for Voluson® 730.

WARNINGS !

- The biopsy lines must be programmed once by the service personnel or by the user.
  The procedure must be repeated if probes and /or biopsy guides are exchanged.
- Before performing a biopsy, make sure that the displayed biopsy line coincides with the needle track (check in a bowl filled with approx. 47°C warm water!).
- The needle used for this alignment verification must not be used for the actual procedure.
  Always use a straight, new and sterile needle for each biopsy procedure.

2.8 ECG-preamplifier (MAN)

The ECG preamplifier type MAN is an option of the ultrasound scanner unit, used to obtain an ECG signal to mark the systolic and end-diastolic moments in M mode and Doppler evaluations.

WARNINGS !

- The MAN is not intended for ECG diagnosis. It must not be used for an intra-operative application of the heart.
- Monitor: Not for use as a cardiac monitor.
- Only the patient cable supplied by GE Medical Systems - Kretztechnik, and only recommended electrodes must be used.
- Take care that neither bare parts of one of the three electrodes nor the patient comes into contact with conductive parts (e.g., metal parts of the examination bed, trolley, or similar).
- If the use of a HF surgical unit with simultaneously connected ECG electrodes becomes necessary, a large distance of ECG electrodes from the surgical field and a perfect position of the neutral electrode of the HF surgical unit must be observed (avoiding burning risk).
- If the use of a defibrillator becomes necessary, there must be no ECG adhesive electrodes and no conductive paste between the correct positions of the defibrillator plates (avoiding current bridge; the signal input of the ECG preamplifier is defibrillator-safe).

For further details and information's please review: MAN ECG preamplifier *(chapter 21)* of the Basic User Manual for Voluson® 730.

2.9 Cleaning and Maintenance

Daily cleaning of the scanner, the probes and the probe holders from coupling gel, mineral oil etc. is recommended, wet cloth and soap are allowed.

CAUTION ! Before cleaning the scanner switch it off. Do not use disinfection spray nor gas disinfection. Electric parts must be protected from drip water. Keep the touchpanel screen clean. Dust and parts on the frame can cause irregular function!
Check the mains cable, transducer cables, plugs and sockets regularly.

Have the system checked and serviced in regular intervals (once per year) by authorized service personnel. In case of total failure first check if mains voltage is present.
Mentioning any observations or failure symptoms to the service engineers is helpful.

2.10 Safety Test

Scan time limits: Acc. to respective national regulations, and acc. to the manufacturer recommendations for the medical-technical unit.

Range:

a) Visual inspection:
Housing, connection, operating elements, display facilities, labels, accessories, user manual.

b) Functional test:
Checking of functions (acc. to user manual), check also modular combinations and common operability of system and accessories.

c) Electric test:
Checking of the electric safety of system combinations acc. to VDE 0751 or respective national regulations.

For safety reasons, avoid handling fluids in the vicinity of the system.

2.11 Manufacturer Responsibility

The manufacturer, assembler, importer or installer considers himself/herself responsible regarding safety, reliability and performance of the instrument under the following conditions:

- when assembling the system, when performing add-ones, when new settings or modifications or repairs were performed by personnel authorized by him/her,
- also that the local electric installation complies to the national regulations, and that the equipment is only used according to the User Manual.

2.12 Service Documents

The Service Manual supplies block diagrams, lists of spare parts, descriptions, adjustment instructions or similar information which help adequately qualified technical personnel in repairing those parts of the instrument which have been defined repairable by the manufacturer.

2.13 Basic interaction between Ultrasound and Matter

2.13.1 Bioeffects

"Diagnostic ultrasound has been in use since the late 1950s. Given its known benefits and recognized efficacy for medical diagnosis, including use during human pregnancy, the American Institute of Ultrasound in Medicine herein addresses the clinical safety of such use:
No confirmed biological effects on patients or instrument operators caused by exposure at intensities typical of present diagnostic ultrasound instruments have ever been reported. Although they indicate that the benefits to patients of the prudent use of diagnostic ultrasound outweigh the risks, if any, that may be present."

Reference: Bioeffects considerations for the safety of Diagnostic Ultrasound - Journal of Ultrasound in Medicine, Vol.7, Number 9 (supplement) - American Institute of Ultrasound in Medicine, Bioeffects Committee.

Please note: Prudent use means that the ultrasound machine is to be used by the operator in accordance with the ALARA principle, i.e. keep the power levels and the exposure time **A**S **L**OW **A**S **R**EASONABLY **A**CHIEVABLE.

An ultrasound bioeffect is any biological mechanism or process, which is produced, triggered or catalyzed by exposure to ultrasound.

One can differentiate two known mechanisms for the development of bioeffects when humans are exposed to ultrasound: the *thermal* effect of ultrasound and the *cavitation*.
With humans no harmful bioeffects due to exposure to diagnostic ultrasound have been noticed.

The rise in tissue-temperature under the influence of ultrasound energy is called *thermal effect*. The level of the temperature rise depends mainly on the following parameters: the irradiated quantity of energy, the surface of exposure and the thermal characteristics of the tissue. Regarding the thermodynamics, the AIUM-report comes to the following conclusions:

- When only the temperature criteria is considered, an exposure to diagnostic ultrasound, leading to a rise in temperature of 1°C above the normal physiological value can be made without limitations in clinical examinations.
- With fetal use a temperature rise in situ beyond 41°C is considered dangerous; the risk of harming the fetus is increased with the duration of this temperature rise.
- For fetal use the following intensities are considered to be safe:
- SATA-intensity (in situ) below 200 mW/cm2 with beam widths of less than 11 wavelengths.
- SATA-intensity (in situ) below 300 mW/cm2 with beam widths of less than 8 wavelengths.

Note that the thermal model of the AIUM does not take into account the influence of tissue blood circulation.

Cavitation concerns the reaction of gas- or vapor bubbles or gas- or vapor accumulations present in tissue or liquids. Two types of cavitation - transient and stable - have been described and investigated in in-vitro and animal tests (Flynn HG, Physics of Acoustic Cavitation in Liquids, in Physical Acoustics: Principals and Methods, edited by Mason, WP, Academic Press, New York, 1964, Vol. I/B, Chap. 9, pp. 57-172).

Transient cavitation means dilatation and quick collapsing of a bubble as a reaction to one or more ultrasound pulse beams. This quick collapse can lead to locally limited (in micrometer range) high temperatures and pressures.

Stable cavitation concerns the repeated oscillation of a bubble. This bubble oscillation can have effects on neighboring cells, especially due to transverse action acting on its membrane and due to disturbance of the contained cytoplasma. Amplitude and frequency of the bubble oscillation are dependent on the bubble size at the beginning and resonance frequency characteristics as well as on frequency and pressure of the impinging ultrasound. With tissue of mammals the scientists came to contradictory results regarding the ability to produce cavitation. This is possibly due to differences in the occurrence of cavitation germs (bubbles). Very little is known about the factors determining the presence or absence of micro bubbles, their chemical consistence and visco-elastic characteristics. The results of cavitation tests also depend on ambient pressure, on the acoustic energy and the pressure level. With the output power used in diagnostic ultrasound no cavitation was observed in vivo.

The AIUM-report reaches the following conclusions regarding cavitation:
- Cavitation can occur with short pulses and produces potentially harmful biological effects.
- A peak pressure of 10 MPa (3300 W/cm2) can lead to cavitation with mammals.

With the limited data available it is not possible to specify *threshold values* for the pressure amplitude at which - when using diagnostically relevant pulse lengths and pulse repetition frequencies - cavitation occurs with mammals.

Some scientists observed that the peak rarefaction pressure (pr) of the transmitted disturbance is related closer to occurrence of cavitation than to the overall measured peak pressure (due to compression plus rarefaction). Other examinations showed that the peak rarefaction pressure of the basic oscillation component of the disturbance could be among the three mentioned parameters the most closely related to the cavitation.

The following results are contained in the AIUM-report too:

- *Other acting mechanisms* - no other acting mechanisms for bioeffects are known, that are caused by exposure to diagnostic ultrasound.
- *Epidemiology* - in more than 25 years of extensive clinical ultrasound application no harmful effects due to exposure to diagnostic ultrasound have become known.
- *Bioeffects in vivo with mammals* - no significant bioeffects in vivo independently confirmed could be determined under the following conditions:
- Unfocussed exposure with an SPTA-intensity of less than 100 mW/cm2 in an exposure period of less than 500 seconds (measured in water).
- Focused exposure with an SPTA-intensity of less than 1 W/cm2 in an exposure period of less than 50 seconds (measured in water).
- Product from intensity (measured in water) and time of exposure less than 50 joule/cm2.

2.13.2 Intensities Measured in Water and recalculated In Situ

All intensity parameters are determined by measurement in water. As water does not absorb the acoustic energy, these measurements in water represent the most unfavorable value. In biological tissue however the acoustic intensity is absorbed. The "real" value in a given position depends on the amount and type of tissue through which the ultrasound beam passes and on the ultrasound frequency. The value in tissue (**in situ**) can be approximately determined with the following formula:

$$in\ situ = water\ [\ e^{-(0.23dlf)}\ ]$$

Whereas:

	in situ	=	value in situ
	water	=	value in water
	e	=	2.7183
	d	=	attenuation coefficient
	l	=	distance from skin surface to measuring depth (cm)
	f	=	mean frequency of combination probe/system/operation mode (MHz)

tissue	d (dB/cm/MHz)
brain	0.53
heart	0.66
kidney	0.79
liver	0.43
muscle	0.55

As the ultrasound generally crosses tissue layers of different thickness and different types on its way through the body during an examination, it is very difficult to estimate the real intensity *in situ*.
For reports generally an impedance coefficient of 0.3 dB/cm/MHz is assumed. The value in situ that is generally indicated in reports is calculated according to the following formula:

$$\text{in situ (recalculated)} = \text{water } [e^{-(0.69lf)}]$$

As this value must not be considered as the real intensity in situ, the term "recalculated" is used hereunder.

In some cases the max. Recalculated value and the max. Value in water do not occur under the same operating conditions. Therefore the max. Values in water and recalculated max. Values mentioned in reports may not be related according to the above mentioned formula.
For example: An array probe with multiple focusing, whose max. Intensity values in water are lying in the deepest focal zone; for this zone, however, the smallest recalculating factor is valid. With the same probe the highest recalculated intensity can be lying in one of the focal zones closest to the surface.

The FDA has laid down limits for the max. recalculated intensity values (see following section). Therefore the recalculated intensities are brought to the highest possible value with the help of the system controls when the output power is tested. Under all operating conditions the point of the max. Recalculated intensity can be closer to the probe than the point of the max. Intensity in water; it will never be further away from the transducer.

2.13.3 Derivation and Meaning of the thermal and mechanical Indices

The Standard for real-time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic Ultrasound Equipment, ©1992 by the American Institute of Ultrasound in Medicine (AIUM) and the National Electrical Manufacturers Association (NEMA), defines Thermal and Mechanical Indices as follows. Please refer to this standard to get further information on this matter.

Thermal Index (TI) is a quantity related to calculated or estimated temperature rise under certain defined assumptions. The Thermal Index is the ratio of total acoustic power to the power required to raise tissue temperature by 1°C under defined assumptions. In the calculation of all Thermal Indices in the "Standard for real-time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic Ultrasound Equipment", of the AIUM and NEMA, the average ultrasonic attenuation is assumed to be 0.3 dB/cm-MHz along the beam axis in the body.

Soft Tissue Thermal Index (TIS) is the Thermal Index related to soft tissues.

Bone Thermal Index (TIB) is the thermal index for applications, such as fetal (second and third trimester) or neonatal cephalic (through the fontanel), in which the ultrasound beam passes through soft tissue and a focal region is the immediate vicinity of bone.

Cranial Bone Thermal Index (TIC) is the Thermal Index for applications, such as pediatric and adult cranial applications, in which the ultrasound beam passes through bone near the beam entrance into the body.

Mechanical Index (MI) formula is the spatial-peak value of the peak rare factional pressure, derated by 0.3 dB/cm-MHz at each point along the beam axis, divided by the square root of the center frequency. To make the MI unitless, the right-hand side of the equation below is multiplied by [(1 $MHz)^{0.5}$/(1 Mpa)].

Scanned mode (auto-scanning) is the electronic or mechanical steering of successive ultrasonic pulses or series of pulses, through at least two dimensions.

Unscanned mode (nonautoscanning) is the emission of ultrasonic pulses in a single direction, where scanning in more than one direction would require moving the transducer assembly manually.

Name	Formula
A. Soft Tissue at Surface TIS (scanned) TIB (scanned)	$$TI = \frac{W_{0I}}{\left(\frac{210}{f_c}\right)}$$
B. Large Aperture (A>1 cm²) TIS (unscanned)	$$TI = \frac{\max_{z >= z_{bp}} [\min[W_{.3}(z)\, I_{TA.3}(z) * 1\,cm^2]}{\left(\frac{210}{f}\right)}$$
C. Small Aperture (A≤1 cm²) TIS (unscanned)	$$TI = \frac{W_0}{\left(\frac{210}{f_c}\right)}$$
D. Bone at Focus TIB (unscanned)	$$TI = \min\left[\frac{\sqrt{W_{.3}(z_{B.3})\, I_{TA.3}(z_{B.3})}}{50}, \frac{W_{.3}(z_{B.3})}{4.4}\right]$$ where $z_{B.3}$ = the depth that maximizes $W_3(z)I_{TA.3}(z)$, or, equivalently, the depth of $I_{SPTA.B.3}$
E. Bone at Surface TIC	$$TI = \frac{W_0}{40\, D_{eq}}$$

Symbol	Definition
A_{aprt} (cm^2)	Active aperture area
$d_{eq}(z)$ (cm)	Equivalent beam diameter $$d_{eq}(z) = \sqrt{\frac{4 W_0(z)}{\Pi I_{TA3}(z)}} \left(= \sqrt{\frac{4 W_0}{\Pi I_{TA3}(z)}} \right)$$
D_{eq} (cm)	Equivalent aperture diameter $$D_{eq} = \sqrt{\frac{4}{\Pi} A_{aprt}}$$
f_c (MHz)	Center frequency
$I_{SPTA.3}$ (mW/cm^2)	Equivalent to the spatial peak temporal average derated (0.6 dB/cm-MHz) intensity.
$I_{TA.3}$ (mW/cm^2)	Temporal average intensity derated to depth z
W_0 (mW)	Time average acoustic power at the source
W_{01} (mW)	Time average acoustic power at the source emitted from the central one centimeter of the active aperture
$W_{.3}(z)$ (mW)	Time average acoustic power derated to depth z
W/X (mW/cm)	A symbol that denotes acoustic power per unit linear length, e.g., of a linear array
z (cm)	Depth from the surface along the beam axis
z_{bp} (cm)	Break point depth (minimum depth for intensity measurements for the TIS (unscanned) model) $z_{bp} = 1.5D_{eq}$
$z_{B.3}$ (cm)	Depth of the maximum temperature rise in the bone at focus model.

Reference: Standard for Real Time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic Ultrasound Equipment -
©1992 by American Institute of Ultrasound in Medicine (AIUM) and National Electrical Manufacturers Association (NEMA).

2.13.4 FDA-Limits for Acoustic Output and Bioeffects

The American Food and Drug Administration (FDA) has laid down maximum values in situ * (recalculated) for different clinical applications, which are valid independent of the operation mode (2D, M-Mode, Doppler). These values are not defined on the basis of the ultrasound bioeffects, but are based on the output power of instruments, that were manufactured prior to the modification of FDA-Regulations 1976. The enclosed acoustic output tables contain the recalculated limits as laid down by FDA and the values mentioned in the AIUM-report.

- Contains the recalculated limits as laid down by FDA and the values mentioned in the AIUM-report.
- No limits were laid down by the FDA for measurements in water.

2.13.5 Summary

1. Presently limits for the output power are laid down neither by the FDA, nor by AIUM-report of the Bioeffects Committee. Thermal models in development in 1991 include the output power.

2. The AIUM report contains no specific conclusions regarding an I_{SPPA} within the FDA limits.

3. The I_{SPTA} is a relevant parameter regarding bioeffects. The FDA limits and the values recommended by the AIUM concerning bioeffects are compatible. In some of the thermal model in development in 1991 there is an I_{SPTA} factor.

4. The AIUM report does not contain any specific conclusions regarding an I_{MAX} within the FDA limits. Presently (1991) the FDA considers to renounce to the I_{MAX} as a parameter of the output power to be reported.

5. Presently the FDA considers a cavitation parameter the mechanical index MI which is based on Pr. The limit for MI is 1.9.

6. The FDA considers I_{SATA} as a relevant parameter regarding bioeffects. The FDA limits for the I_{SATA} are not based on bioeffects; they are rather based on the output power before the regulation modification 1976.

7. No limits for the measurement in water were laid down.

8. In some cases the tissue can be exposed to sound and intensity values that are higher than those given (recalculated) for *in situ*. In these cases the reported values *in situ* do not represent the worst case of exposure. But this case occurs only if the tissue has an attenuation coefficient below 0.3 dB/cm/MHz, e.g. with a long way through liquids and a short way through tissue. In such cases an output power of less than 100% is recommended; therefore the examiner should reduce the power in order to reduce sound intensity impinging on the tissue.

2.13.6 Display Accuracy of the Indices

On the right side of the monitor display the thermal and mechanical indices are displayed.
While scanning, notice the index numbers you are using and which controls affect the readings.
Try to keep the index numbers as low as you can, while maintaining diagnostic information within the image. This is particularly important when scanning the fetus. The display accuracy of the mechanical index and all thermal indices is 0.1. Values below 0.4 are not displayed.

Reference: "Standard for real-time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic Ultrasound Equipment", AIUM/NEMA, Washington, DC, 1992.

2.13.7 Recommendation to use and for the Need for following the ALARA Principle

The AIUM publication "Medical Ultrasound Safety", published 1994 by the AIUM says the following about the ALARA principle:

The ALARA principle "stands for 'As Low As Reasonably Achievable'. Following the ALARA principle means to keep the total ultrasound exposure as low as reasonably achievable, while optimizing diagnostic information.

With the new ultrasound equipment, the output display lets us determine the exposure level in terms of the potential for bioeffects...", and "Because the threshold of diagnostic ultrasound bioeffects is undetermined, it becomes our responsibility to control the total exposure to the patient. Controlling the total exposure depends on output level and exposure time. The output level required for an exam depends on the patient and on the clinical need. Not all diagnostic exams can be performed at very low levels. In fact, using too low levels may result in poor data and the need to repeat the examination. Using too high a level may not increase the quality of the information, but it will expose the patient to unneeded ultrasound energy."

"Ultimately, the exposure time depends on the person conducting the exam. Primarily, it's our training, education, and experience that determine how quickly we can obtain a useful image, and thus, the length of the exam and the amount of exposure. So, the question is 'How much time do we need to obtain the desired diagnostic information?'" The AIUM also lists some other factors that might affect the length of exposure time, like if there is a moving or a stationary beam, what kind of transducer is chosen, what is the body characteristic of the patient, if the operator is understanding the controls of the system, and how they affect output levels, whether it's continuous or pulsed, or color flow Doppler.

"To achieve ALARA, we need a thorough knowledge of the imaging mode, transducer capabilities, system setup, and operator scanning techniques."

GE Medical Systems-Kretztechnik Ultrasound therefore recommends careful studying of the system's manual to become familiar with the operating controls and output display of the system as well as with following the ALARA principle. This might decrease the risk of any potential biological hazard caused by ultrasound exposure during an examination!

Reference: Medical Ultrasound Safety, AIUM 1994
AIUM Executive Office
14750 Sweitzer Lane,
Suite 100, Laurel, MD 20707-5906, USA

Please note that the above referenced AIUM publication is attached to this manual.

2.13.8 Notes for Acoustic Output Tables for Track 3

Operating Conditions: means the adjustment of the scan parameters on the ultrasound console

MI: is the Mechanical Index in an auto-scanning mode.

TIS_{scan}: is the Soft Tissue Thermal Index in an auto-scanning mode.

$TIS_{non\text{-}scan}$: is the Soft Tissue Thermal Index in a non-auto scanning mode.

TIB: is the Bone Thermal Index.

TIC: is the Cranial Thermal Index.

A_{aprt}: is the area of the active aperture (square centimeters).

$p_{r.3}$: is the derated Peak Rare factional Pressure (megapascals).

W_0: is the ultrasonic power, except for TIS_{scan}, in which case it is the ultrasonic power passing through a one-centimeter window (mill watts).

$W_{.3}(z_1)$: is the derated ultrasonic power at axial distance z_1.

$I_{SPTA.3}(z_1)$: is the derated spatial-peak, temporal-average intensity at axial distance z_1 (mill watts per square centimeters).

z_1: is the axial distance corresponding to the location of $\max[\min(W_{.3}(z).I_{TA.3}(z) * 1\ cm_2)]$, where $z^3 z_{bp}$ (millimeters).

z_{bp}: is $1.69(A_{aprt})^{1/2}$.

For MI, z_{sp}: is the axial distance at which $p_{r.3}$ is measured; for TIB, z_{sp} is the axial distance at which TIB is a maximum (i.e. $z_{sp} = z_{b.3}$) (millimeters).

$d_{eq}(z)$: is the equivalent beam diameter as a function of axial distance z, and is equal to $[(4/p)(W_0/I_{TA}(z))]^{1/2}$, where $I_{TA}(z)$ is the temporal-average intensity as a function of z (millimeters).

f_c: is the center frequency (megahertz).

EBD: 1 - 12 are the entrance beam dimensions for the azimuthal and elevational planes (millimeters).

PD: is the pulse duration (microseconds).

PRF: is the pulse repetition frequency (kilohertz).

p_r at Pll_{max}: is the peak rare factional pressure at the point where the free-field, spatial peak pulse intensity integral is a maximum (megapascals). (See section 6 of the Standard for Real-Time Display of Thermal and Mechanical Indices on Diagnostic Ultrasound Equipment, entitled "Measurement Methodology for Mechanical and Thermal Indices", § 6.2.6.1.)

FL: is the focal length, or azimuthal and elevational lengths, if different (millimeters).

ROC: is the radius of curvature (millimeters).

d_{eq} at Pll_{max}: is the equivalent beam diameter at the point where the free-field, spatial-peak pulse intensity integral is a maximum (millimeters). (See Section 6 of the Standard for Real-Time Display of Thermal and Mechanical Indices on Diagnostic Ultrasound Equipment, entitled "Measurement Methodology for Mechanical and Thermal Indices", § 6.2.6.1.).

Reference: Revised 510(k) Diagnostic Ultrasound Guidance for 1993; CDRH, FDA; Feb. 17, 1993

2.13.9 Acoustic Measurement Uncertainties

I_{SPTA}:	±	16%	MI:	±	10%
I_{SPPA}:	±	17%	TIB:	±	35%
Pr:	±	10%	TIS:	±	19%
F_c:	±	1%	TIC	±	21%
W:	±	19%			

2.13.10 Acoustic Output Tables

Acoustic Output Tables (acc. to Track 3 as demanded in the Revised 510(k). Diagnostic Ultrasound Guidance for 1993; CDRH, FDA; Feb. 17, 1993), respectively guidance ***Information for Manufacturers Seeking Marketing Clearance of Diagnostic Ultrasound Systems and Transducers*** issued on September 30, 1997:

Please read the safety section for the complete explanation of the acoustic output in the User's Manual of the respective probes.

2.14 3D-Resolution and Sensitivity

- All resolution and sensitivity claims are based on phantom testing only.
  These claims do not directly correspond to or imply clinical performance.

NOTE: All system claims made are based on testing done with Dr. Madsen's phantom.

DESCRIPTION OF Dr. MADSEN'S PHANTOM

The phantom is designed and constructed by Ernest L. Madsen, Ph. D., in the Department of Medical Physics at the University of Wisconsin Medical School.

This 3D ultrasound phantom contains two sets of spherical targets. All spherical targets in the same set have coplanar centers and the same diameter and identical contrasts[a] over the total depth of 15cm. The center-to-center separation between adjacent spheres is 0.5cm in the vertical plane and 1.5cm in the horizontal plane.

Specifications:		
	Dimensions (h x w x d):	20cm x 18cm x 8cm
	Housing Material:	Acrylic
	Wall Thickness:	1 cm
	Scan Surfaces:	1
	Scan Surface Material/Dimension:	Saran Wrap 2.5mm
	Scan Surfaces Dimensions:	15cm x 5cm

We can reconstruct high contrast spherical images in the 3 to 5 mm diameter range in 3 orthogonal planes only for targets that have negative contrast of at least -17dB (for 3mm and 4mm) / -14dB (for 5mm) backscatter relative to the background level (based on Dr. Madsen's phantom).
This is because the -17dB / -14dB contrast levels were the only high contrast levels tested.

- We can detect large targets, i.e., spheres of 3, 4, and 5 mm in diameter.
  This pertains only high contrast large targets (i.e., contrast of -17dB / -14dB or higher).

- We can detect large targets, i.e., sphere of 5 mm or larger in diameter.
  This pertains only low contrast large targets (i.e., contrast of at least +3dB).

NOTE: The resolution in orthogonal, reconstructed plane is considerably lower than that of the primary scan plane. The system resolution is particularly lower for low contrast targets in the reconstructed, orthogonal plane.

Significant system artifacts may exist in the orthogonal plane parallel to the face of the probe.

[a] Defining the backscatter coefficient of the material forming the lesions to be B_l and that the background material to be B_{bg}, the contrast is defined (in dB) as $10 \log_{10} (B_l / B_{bg})$.

2.15 Measurement Accuracy of the System

Measurements must never be made in a hurry, accurate positioning of the measuring cross or measuring dots is necessary especially with area/circumference measurements.
Despite the high technical accuracy of the scan geometry and the measuring system of the VOLUSON® 730 equipment one must, however, be aware of inaccuracies caused by the ultrasound beam properties and the physiological properties of the scanned structures, tissues and fluids.
For the reason of improved lateral resolution you should choose the proper scanhead for the depth range of the structure to be measured.

The table shows the inaccuracies to be taken into account for measurements.

	Accuracy	**Range**
Distance	+/- 3 %	range of the system according to German KBV-regulations
Area	+/- 6 %	
Circumference	+/- 3 %	
Volume	+/- 9 %	

Explanation:

Distance error: < +/- 3% (or max. 1mm for an object < 30mm)
Area: < +/- 6% = Distance 1 x Distance 2
Volume: < +/- 9% = Distance 1 x Distance 2 x Distance 3

a) Test Phantom: Multi-purpose phantom, Model 539, from ATS Laboratories Inc,
b) Wire Grid phantom in water bath at 47° C, accuracy of wire spacing 0.2 mm

2.16 Disposal

When disposing “Follow local governing ordinances and recycling plans regarding disposal or recycling of device components”.
The instrument does not pose any unusual threat when disposing of it.

3. Description of the System 3-2

3.1 Product Description 3-2
3.1.1 Biological Safety 3-3
3.1.2 Limitation Vectors 3-3
3.1.3 Bioeffects 3-4

3.2 Mechanical Design 3-4
3.2.1 System Configuration 3-4
3.2.2 Mechanical Adjustment 3-5

3.3 System Assembly 3-6
3.3.1 Basic System 3-6
3.3.2 Optional Modules 3-6
3.3.3 Optional Peripheral 3-7

3.4 Concept of Operation 3-7

3.5 Layout of menus 3-8
3.5.1 Layout of the 2D-Mode Main Menu 3-9
3.5.2 Changing of Menus 3-10
3.5.3 Position of Display Annotation 3-10
3.5.4 Control Panel 3-12

3.6 Hardkeys 3-13
3.6.1 Function of the Trackball at Diverse Dialog Pages 3-17

3. Description of the System

3.1 Product Description

The VOLUSON® 730 is a professional, innovative, most versatile real-time scanning system.
It opens new sonographic possibilities with 3D/4D-VOLUME scanning technique.
The vast program of probes makes it suitable for many applications.

The system offers the following diagnostic possibilities:

- 2D Mode
- M Mode
- Spectral Doppler (Pulsed- and Continuous Wave)
- Color-Doppler (Velocity-, Power-, Tissue imaging)
- Volume Mode (3D sectional image analysis interactive 3D rendering and Real Time 4D)

Medical application fields:

- Radiology
- Obstetric and Gynecology
- Urology
- Cardiology
- Surgery
- Oncology
- Ophthalmology
- Orthopedics
- Pediatrics

Note: The application fields are dependent of the selected probe.

The system is designed for follow-up expansion.

Operable probes:

- Multi-element probes (linear array, curved array, phased array and pencil probes)
- Volume probes
  - Voluson 3D probes
  - Real Time 4D probes

The operation is designed for the specific clinical requirements and ensures simple and efficient handling. A vast range of measuring and evaluation programs, as well as many special functions enable comfortable working. An SCSI-interface with interface software provides quick digital archiving of images and/or volume data sets on mass storage medium.
A network interface(Ethernet) provides documentation in DICOM-standard.

Under the provision of regular maintenance by authorized service personnel the life expectancy is about 10 years from the manufacturing date.

3.1.1 Biological Safety

The biological effects of diagnostic ultrasound on the human body have not been entirely investigated yet. So far no damages by ultrasound diagnosis are known, still the instrument should only be used by a medical doctor or under his supervision.
The ultrasound examination should be performed in as short of a time as possible and with the lowest transmit power available to enable diagnostic results (ALARA principle, **A**s **L**ow **A**s **R**easonably **A**chievable).
The VOLUSON® 730 permanently controls the emitted power and limits it acc. to the maximum values set by the manufacturer (sound field limiting vector). The occurring sound intensities depends on the respective probes. The declaration of sound field parameters acc. to IEC 1157 can be obtained from the manufacturer on request.

3.1.2 Limitation Vectors

The table shows the limits for the following FDA and IEC parameters.

naming	unit	limits FDA-version	limits IEC-Version
Ispta.3	mW/cm²	720	720
pr	MPa	-	4.0
MI	-	1.9	-
TIB	-	4.0	-
TIS	-	4.0	-
TIC	-	4.0	-
DT	°C	5.0	5.0
W	mW	-	333

These values are individual Presets for FDA or IEC, and can only be changed in the company.
Review also: Notes for Acoustic Output Tables for Track 3 *(chapter 2.13.8)*

3.1.3 Bioeffects

One distinguishes between two acting mechanisms for the development of Bioeffects when exposing the human body to ultrasound waves: Heat Generation and Cavitation.
Heat generation: the ultrasound energy is absorbed by the tissue and warms it up, the amount of heat depending on the absorbed power and duration of exposure. A part of the heat is dissipated into the blood stream.
Cavitation: due to a strong negative pressure gas bubbles appear. The permanent change between gas and liquid phase constitute strong local mechanical stress in the tissue. The degree of cavitation is influenced by the gas content and the superficial tension of the tissue resp. of body fluid.

3.2 Mechanical Design

3.2.1 System Configuration

MONITOR
rotate – and inclinable

CONTROL CONSOLE
rotatable

Touchpanel Display

Probe Holder

Loudspeaker

Place for different disk drives

Place for Printer and VCR

Standby switch

Probe connector module

Foot rest

3.2.2 Mechanical Adjustment

The control console can be rotated 30° to the right.

TRANSPORT LOCK

There is a lever for locking and unlocking the control console, mounted at the front below the control console. When preparing the system for transport, the lock shall be engaged in order to secure the console against uncontrolled rotation. The bolt set to the locking position, the lock catches in when the console is rotated to its center 0° position.

ROTATION OF THE CONTROL CONSOLE

When rotating the control console grasp it only at the front handle of the user interface.

1. Pull the lever under the control console forward.
2. Rotate the console to desired position.

WARNING:

- Do not put your hand between the control console and the main unit when moving it to the 0 position: Danger of injuries!
- Do not pull or lift the system with the front handle of the user interface.

MOVING OR LIFTING THE SYSTEM

When pulling, moving or lifting the system, grasp it only at the rear handle of the trolley and the handle underneath the foot rest.

CAUTION:

Two people are required whenever a part weighing 16 kg (35 lb.) or more must be lifted.

3.3 System Assembly

3.3.1 Basic System

It consists of the following modules:

1. Probe connector module:

This module houses the entire electronics with for connections, up to 3 probe connectors and the beamformer module (transmit and receive electronics).

2. Control console:

The control console consists of the touchpanel, the hard keys, digipots and trackball, the loudspeakers, and the probe holders.

3. Color monitor

4. Trolley:

All modules mentioned above are arranged within the trolley. There are 4 wheels. The front wheels are equipped with locking brakes. Underneath the control console is space for auxiliary equipment (e.g., SCSI-drives).

5. Doppler module:

Spectral Doppler module enables the evaluation of blood flow ratios with pulsed and continuous wave and is built into the main electronic module.

Color-Doppler module enables color-coded evaluation of blood flow conditions and is built into the main electronic module.

3.3.2 Optional Modules

Optional modules (CW-Doppler, 3D and 4D Real Time, etc.) according to the pricelist of the Voluson 730.

3.3.3 Optional Peripheral

Video Printer (black/white)
Digital Color Printer (SCSI, USB)
Line Printer
Videotape Recorder (S-VHS)
Footswitch
ECG preamplifier (MAN)

Actual type review product catalog of Voluson® 730.

WARNING ! The leakage current of the entire system including any/all auxiliary equipment must not exceed the limit values as per EN60.601-1:1990 (IEC 60601-1) resp. other valid national or international standards.

Remark: Optional devices (Printer, VTR, etc.) according to the pricelist of the VOLUSON 730 unit fulfill the electrical safety requirements.

Connection of auxiliary equipment, see: To connect internal and external Accessories *(chapter 6.2)*.

Respectively see *(chapter 20.2)* of the Basic User Manual for Voluson® 730

3.4 Concept of Operation

The control center is the console with the digipot controls , the hardkeys and the trackball arranged below it. They are controlling frequently used functions, e.g. Freeze/Run , change of modes etc. Additional functions are controlled via the touchpanel.

TOUCHPANEL

The touchpanel consists of the flat control monitor.

Note: The touchpanel could be blocked by direct sunlight - avoid full sunlight.
The touchpanel will be blocked by any foreign body lying on it, or e.g. by remainder of coupling gel - clean the touchpanel regularly (with a wetted soft cloth).

The touchpanel enables a comfortable control of menus.
Only those touch keys are provided which are necessary for the activated menu.
The touchpanel eases working under dim light condition.

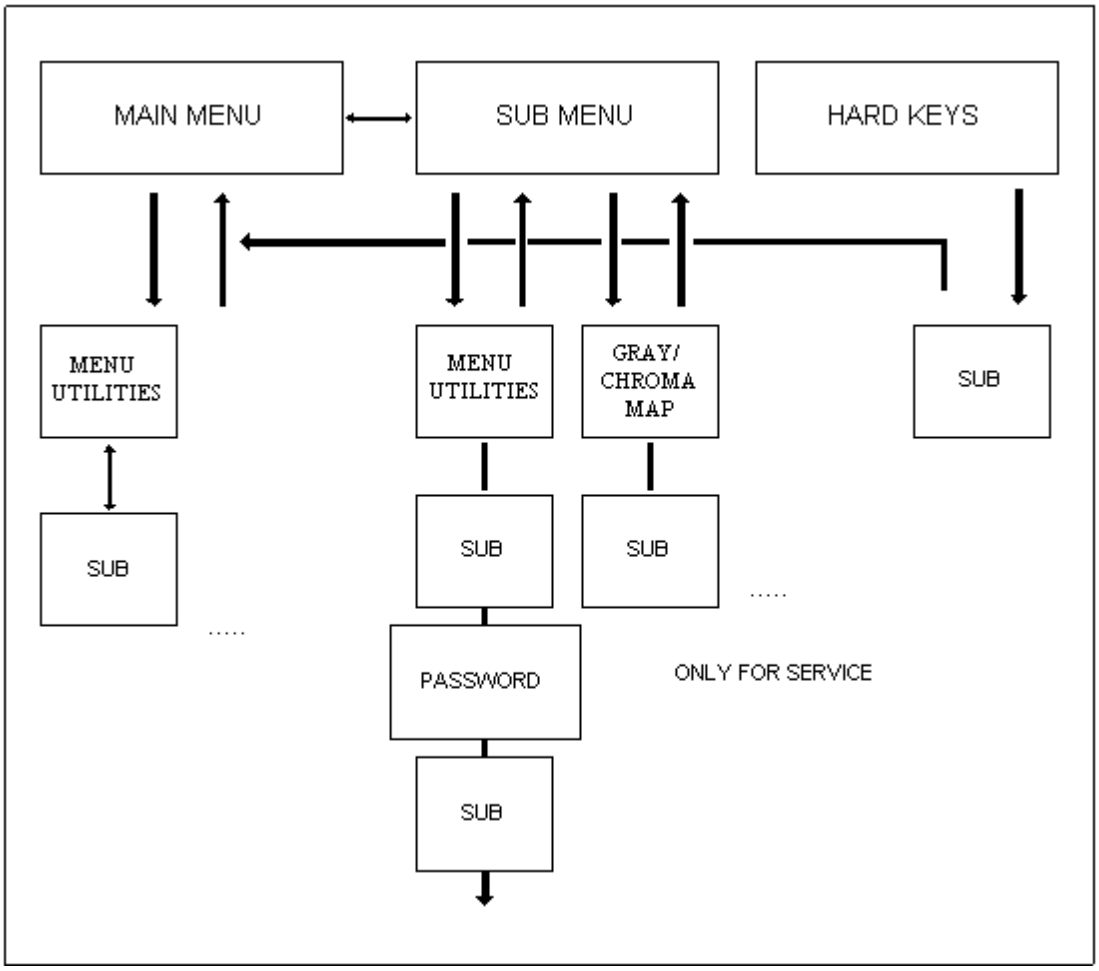
DIGIPOT CONTROLS, TRACKBALL

Activated functions are easily controlled by these controls. When rotated they deliver digital pulses and can be selected by program call-up. They are displayed on the touchpanel screen by their location, their function, and their actual value of setting.

A dual function is marked e.g.: [β-View] [Zoom].
Touching the corresponding symbol causes switching to the second function.

3.5 Layout of menus

Survey:



Mainly two menu levels are used for operating the system, the main-menu level and the sub-menu level. From the main menu the most important sub-menus, e.g. adjusting the 2D image are directly accessible. Some hardkeys activate a specific sub-menu on the touchpanel, e.g. the disc key. Normally changing from one sub-menu to another is made via the main menu, direct call-up from one to another sub-menu is possible in some rare cases only.

3.5.1 Layout of the 2D-Mode Main Menu

All B-Mode operations are started from this menu. It contains 4 main groups of operating functions:

Main group 1: Main menu keys for:
Presets
Sub window probe dependent functions
Image up/down
Image left/right
Trapezoid mode
FFC (Focus and Frequency Composite)
CRI (Compound Resolution Imaging)
Image Angle
β-View (Beta View)
Focal Zones
OTI (Optimized Tissue Imaging)
Frequency

Main group 2: Sub menu keys for:
adjusting the 2D image

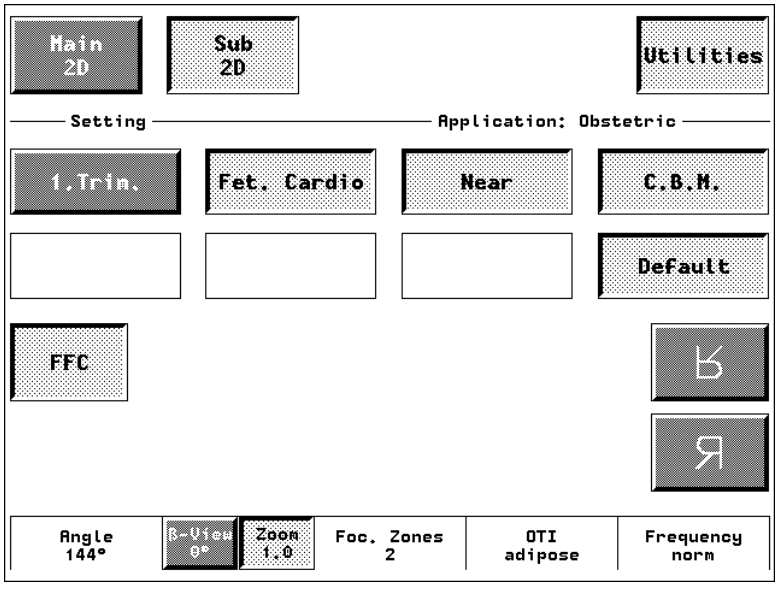
Main group 3: Menu Others keys
System Setup
Biopsy
Histogram
etc.

Main group 4: Change from write-only functions to read-only functions when changing read/write (Freeze/Run):

Remarks:

Selecting a new mode displays a new "Main" menu with the operating functions of this mode.
The keys for the functions Focus, OTI, β-View, Frequency, Angle, Trapezoid mode, FFC and CRI only appear on the touchpanel if they are available for the selected probe.

Example:



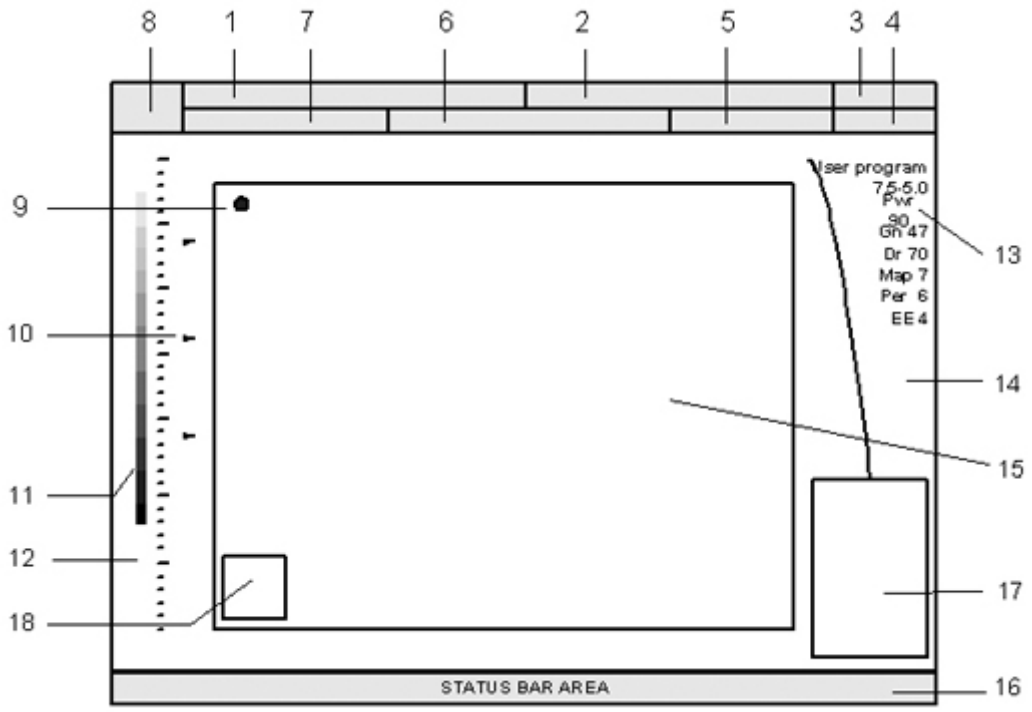
3.5.2 Changing of Menus

Each menu has its own menu key with a "topic" name. By touching the menu key the referring menu appears on the touchpanel. The keys for the different sub-menus can be found next to the Menu main key on the touchpanel.
The [Utilities] key is available in all main menus in the top right corner of the touchpanel.

Remark:

If no probe is selected, the "PROBE/PROGRAM" menu is displayed.

3.5.3 Position of Display Annotation



1.) Patient Name (family, given, prefix)
2.) Hospital ID
3.) Date
4.) Time
5.) Depth / Frame rate
6.) Probe / Application
7.) ID Number
8.) Logo
9.) Orientation marker
10.) Focal zone marker(s)
11.) Gray scale wedge
12.) Depth scale marker
13.) Image Info
14.) TGC curve
15.) Image area
16.) Status bar
17.) Measurement results
18.) Body marker

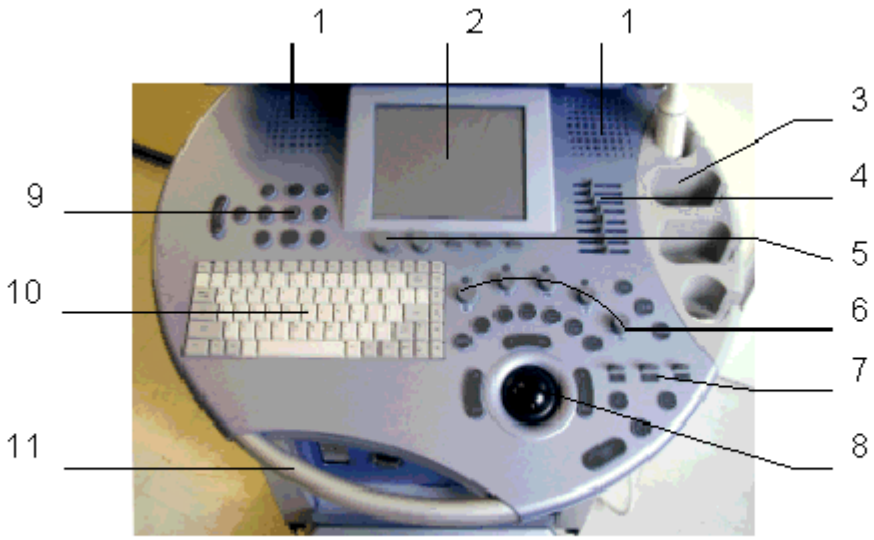
Image Info:	**B (2D) Mode**
User program	Name of user program
7.5-5.0	Receiver frequency [MHz]
Pwr -3	Acoustic power [dB]
Gn -12	Gain [dB]
C5 / M7	Dynamic curve [number], and Gray map [number]
P6 / E4	Persistence [number] and Edge enhancement [number]
MI 0.4	Mechanical Index
TIS 0.0	Thermal Index

Image Info:	**M Mode**
Gn 10	Gain [dB]
150/C1	max. Dynamic range [dB] and selected Dynamic curve [number]
EE 1	Edge enhancement [number]
Rej 10	Reject [number]

Image Info:	**D (PW, CW) Mode**
Gn 10	Gain [dB]
WMF mid	Wall motion filter [Hz]
SV Angle 60°	Angle correction
Size 2.5 mm	Sample volume size
Frq mid	Transmit frequency [Probe data]
PRF 1.2 kHz	Velocity Range [kHz, cm/s, m/s]

Image Info:	**CFM-Mode, PD-Mode**
User program	Name of user program
7.5-5.0	Receiver frequency [MHz]
Pwr -3	Acoustic power [dB]
Gn -12	Gain [dB]
C5 / M7*	Dynamic curve [number] and Gray map [number]
P6 / E4	Persistence [number] and Edge enhancement [number]
MI 0.4	Mechanical Index
TIS 0.0	Thermal Index
Gn 60	Gain [dB]
Bal 120	Balance [number]
Qual mid	Quality of CFM [table]
WMF mid	Wall motion filter [table]
PRF 1.2 kHz	Velocity Range [kHz, cm/s, m/s]
Displ. V	Display Mode [wedge]

3.5.4 Control Panel



1. Loudspeaker positions
2. Touchpanel screen
3. Probe holder
4. TGC Slider control
5. Touchpanel digipot and toggle switch controls
6. Mode keys (digipot controls)
7. Toggle switch controls
8. Trackball
9. Hardkeys
10. Keyboard
11. Grip for moving the unit and rotating the control console

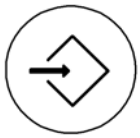
3.6 Hardkeys

NOTE: The chapter references refer to the Basic User Manual for Voluson® 730.

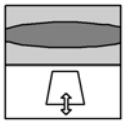
Read/Write (Freeze/Run)
when bright: image is frozen (Read-Mode)
when dark: real-time scan (Write-Mode)
review: To freeze an Image *(chapter 4.5.2)*

Printer Trigger A
Remote trigger key for B/W-Printer, Color printer, DICOM Printer
key setup review: Peripherals *(chapter 17.3.3)*
operation review: Printing *(chapter 16.1)*

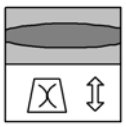
VCR Remote control menu
operation review: VCR Recording *(chapter 16.2)*



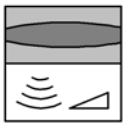
Storage (Inter-memory)
to save images, volumes as well as cine sequences in the Sonoview or to send them to an external DICOM server
operation review: Sonoview *(chapter 15)* and Saving *(chapter 16.3)*



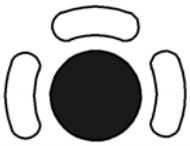
Depth
select the display depth of the 2D image
operation review: 2D Mode Depth *(chapter 5.2)*



Focus
select the position of the transmitter focus
operation review: Transmitter Focus *(chapter 5.7)*



Power
set the acoustic output of the system
operation review: Transmit Power *(chapter 5.6)*



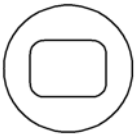
Trackball and Trackball keys
trackball: positions cursors, Cine/Loop, position and size of the box, etc.
upper trackball key: changes the actual trackball function
left/right trackball key: sets, fixates cursors and activates pages/buttons, etc.

HR-Zoom (magnification) on/off
operation review: High Resolution Zoom *(chapter 5.18)*

Calculations
operation review: Calculations and Patient Reports *(chapter 14)*
OB Calculations
GYN Calculations
Cardio Calculations
Vascular Calculations

User measurement
for activation of the last used measurement

Basic Measurement
operation review : Basic Measurements *(chapter 13)*



Clear All
to clear graphics, measurements and annotations on the screen

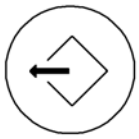
Bodymark
enter Bodymark symbols on the screen
operation review: Pictogram *(chapter 4.7.4)*

Image Annotation
write onto the screen for documentation
operation review: Image Annotation *(chapter 4.7)*

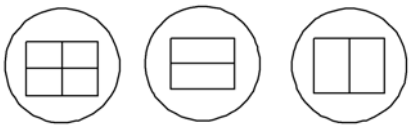
Volume Mode
activates activates 3D Volume Mode, Real Time 4D Mode, Live 3D Mode, VCI (Volume Contrast Imaging), Real Time 4D Biopsy and VOCAL.
operation review: Volume Mode *(chapter 11)*

Harmonic Imaging
on/off key for Harmonic Imaging
review: Harmonic Imaging *(chapter 5.8.1)*

Continuous wave Doppler
on/off key for Continuous Wave Doppler
review: CW Mode *(chapter 7.2)*



no function



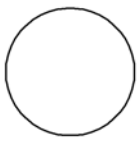
Screen Format
select the display format (Quad and Dual screen display)
operation review: Single-Screen Format
Dual-Screen Format *(chapter 5.15.1)*
Quad-Screen Format *(chapter 5.15.2)*

Report
Patient report page;
operation review: OB Patient Report *(chapter 14.4)*
GYN Patient Report *(chapter 14.6)*
Cardiac Patient Report *(chapter 14.8)*
Vascular Report *(chapter 14.10)*

Network (Sonoview)
press this key to shift from scan mode to Sonoview
operation review : Sonoview *(chapter 15)*

Probe Program
call-up of the Probe Program menu for selecting a Probe with its related program
operation review: Probe/Program Selection *(chapter 4.5)*

Patient Data Entry
call-up of the patient data entry menu (the previous exam will be closed).
operation review: Entering Patient Data *(chapter 4.6)*

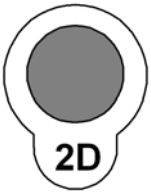


End Exam
Patient and measurement data are stored in the “Data manager” and a “default” set occurs (all temporary patient and measurement data are cleared).
operation review: End Exam *(chapter 4.6.1.1)*

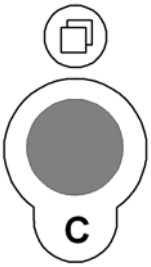
Caution: It is absolutely necessary to press this key before switching OFF the system. Otherwise, the current Patient data as well as all the measurements in the Patient report will be lost.

Printer Trigger B
Remote trigger key for B/W-Printer, Color printer, DICOM Printer
key setup review: Peripherals *(chapter 17.3.3)*
operation review: Printing *(chapter 16.1)*

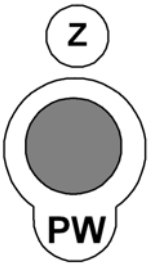
Indicator (Screen arrow)
display a pointer arrow or hand
operation review: Indicator *(chapter 4.7.3)*



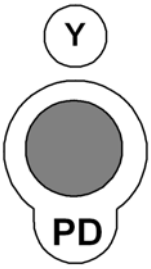
2D Mode (all additional Modes will be switched off)
review: 2D Mode *(chapter 5)*
Pressing this control activates the 2D mode.
Rotating allows setting of the 2D image gain within the probe-defined range.
review: 2D Gain *(chapter 5.4)*



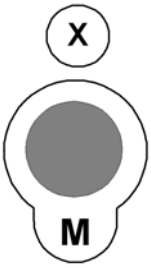
Color Doppler (on/off)
Pressing starts the CFM mode provided the active probe allows function.
Rotating allows setting of the Color-Doppler (CFM mode) gain within the probe-defined range.
With active 3D function on, rotate the control for slicing within the volume.
review: CFM Mode *(chapter 8)*



Pulsed Wave Doppler (on/off)
Pressing starts the PW Doppler mode provided the active probe allows function.
Rotating allows setting of the Pulsed Wave Doppler (PW mode) gain within the probe-defined range.
With 3D-function on, rotation around the Z-Axis within the volume.
review: PW Mode *(chapter 7.1)*



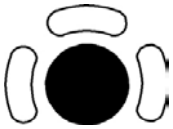
Power Doppler (on/off)
Pressing starts the PD mode provided the active probe allows function.
Rotating allows setting of the Power-Doppler (PD mode) gain within the probe-defined range.
With 3D-function on, rotation around Y-Axis within the volume.
review: PD Mode *(chapter 9)*



Motion Mode (on/off)
Pressing starts the M mode provided the active probe allows function.
Rotating allows setting of the Motion mode (M mode) gain within the probe-defined range.
With 3D-function on, rotation around the X-Axis within the volume.
review: M Mode *(chapter 6)*

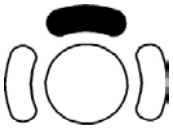
3.6.1 Function of the Trackball at Diverse Dialog Pages

In general operations at diverse dialog pages and windows on the system desktop (e.g., Patient Data Entry, Usage of EUM, System Setup, Measurement Setup, etc.) are done with the trackball and the trackball keys (mouse emulation).



Trackball (mouse position):
positions the pointing device (arrow) on the desktop

left trackball key (left mouse button):
sets, fixates markers and activates pages/buttons etc. marked by the pointing device



upper trackball key (right mouse button):
no function in system desktop

right trackball key (left mouse button):
sets, fixates markers and activates pages/buttons etc. marked by the pointing device

The status bar shows the current trackball functionality:

This page intentionally left blank.

4 Starting the System 4-2

4.1 General Remarks 4-2

4.2 Safety Warnings 4-2

4.3 Turn on Power 4-3

4.4 Transducer Connection 4-4

4.5 Probe/Program Selection 4-5

4.5.1 Starting the System 4-6

4.5.2 To freeze an Image 4-6

4 Starting the System

4.1 General Remarks

Installation, switching on for the first time and check-up of the system must only be performed by authorized persons.

The VOLUSON® 730 is delivered with recommended basic settings. These offer suitable conditions for a large number of applications. Depending on the user's experience these default settings can be changed and stored as new User Programs. Storing these programs or quick loading of new programs of a second user is done by back-ups.

4.2 Safety Warnings

CAUTION ! **In the event the equipment has been brought from cold environment (stock room, airfreight) into a warm room, allow several hours for temperature balance and passing of condensation humidity before switching on the first time (risk of leakage current).**

CAUTION ! **The system is equipped with mains outlets separated by an isolation transformer for peripheral equipment (printer, VCR). To ensure electrical safety, these instruments must never be connected to a wall socket.**

4.3 Turn on Power

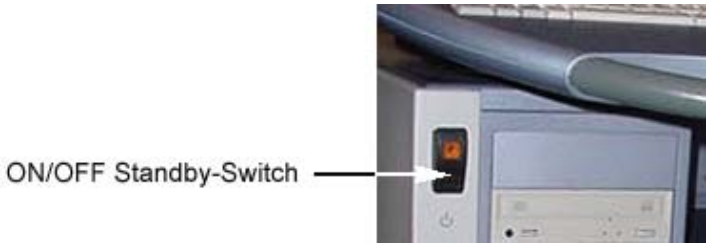
1. Connect the Power Cable to the back of the system.
2. Connect the Main Power Cable to a hospital grade power receptacle with the proper rated voltage.

WARNING: Never use an adapter that would defeat the safety ground.

3. Switch ON the Circuit Breaker and the Power Switch of Peripherals at the rear of the system.

Note: The switch of the monitor has to be in ON position before starting the system.
Leave monitor power switch always ON.

4. Push the ON/OFF Standby switch left below the control panel once.
For its location review: System Configuration *(chapter 3.2.1)*.



Once system is switched on, it is completely reset. The boot-up time is about 2 minutes, and then the 2D mode main menu for the previously selected transducer is displayed.
In case, however, it was disconnected, the menu "PROBE/PROGRAM" will appear.

Remarks:

- The mains outlets of the system for peripheral auxiliary equipment are commonly switched with the Standby switch. The switch of printers has to be in ON position before starting the system. However, be aware some auxiliary equipment may switch itself to standby mode when Standby power is on (e.g., Color video printer) and must therefore be switched on separately. The auxiliary equipment need not be switched ON/OFF separately if the **F2** power switch on the back of the system and the switches of the peripherals are always ON.

- The system's monitor has its own main switch, which is normally always left ON.
If found off, resp. if here is no information on the screen, switch it on.

4.4 Transducer Connection

CAUTION! **Prior to connecting or disconnecting a probe freeze the image.**
It is unnecessary to switch the unit off.
If a probe is disconnected while running (write mode) a software error may occur. In this case switch the unit OFF and later ON (perform a reset).

CAUTION! **If the cable spout on the right-hand door is missing do not pull on the probe cable, the probe cable can be damaged. Please insert the spout in the destined place or call the Service Department.**

1. Plug the probe connector into a free socket.
2. Twist the probe twist lock lever to vertical position to lock it in place.
3. Open the right-hand side door.
4. Lay the cable into the intended cable holder and close the door.

Each probe connector has a mechanical fixation lock which has to be engaged to enable the probe to be working at all.

Probe Connector:

shown unlocked. Turn the knob clockwise to lock.

Note: A disconnection of an active probe is permitted in read mode **only !!!**
If a probe is disconnected while running (write mode) a software error can occur!

Probe holders:

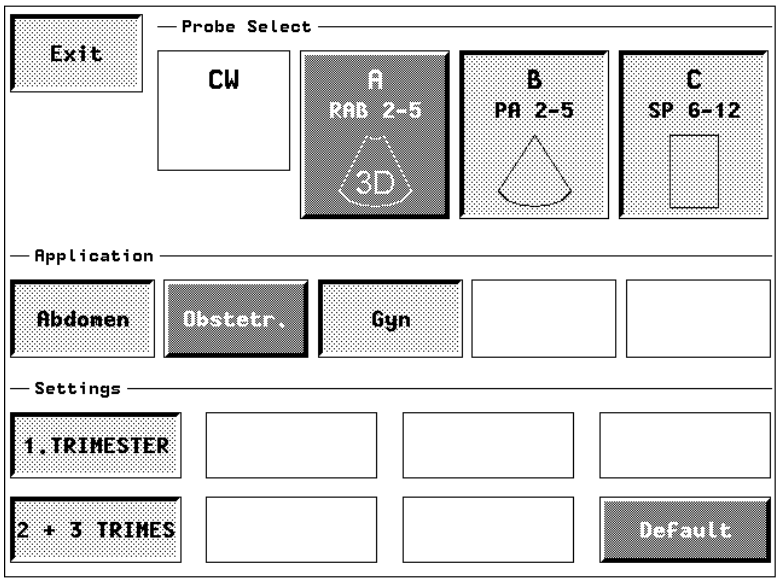
Always store the probes in the intended probe holders.

4.5 Probe/Program Selection

This menu shows the connected probes.
The denomination of each transducer connected to the system appears in the corresponding touchkey (soft key). Probe selection is done by touching the corresponding key. The key with the selected probe is illuminated. At the same time the available applications of the selected probe are displayed in the application field.
Upon selection of an Application, a maximum 7 User program fields appear in the “Settings” field, and a default setting. The Default Setting is not rewriteable for the User.
Program selection is done by pressing the corresponding keys.
For each probe up to 7 programs can be stored.
The Setting enables speedy adjustment of the system for different fields of application.
To store a user setting under an application, review: User Settings *(chapter 17.3.2)* of the Basic User Manual for Voluson® 730.

[Probe] key (hard key):
This key activates and deactivates the "probe select" menu.
Behavior of probe select function, when connecting/disconnecting a probe, review: Transducer Connection *(chapter 4.4)*

Probe selection menu on the touchpanel:



Probe window:
Shows all connected probes, the active one is highlighted (if one is active)

Application window:
Shows all applications for the active probe. The last active application is highlighted.

Setting (program) window:
Shows all settings for the active application. The last active setting is highlighted.

Selection of a probe:

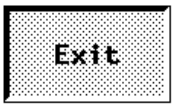
Touch the corresponding probe key.
Each touch key shows the name of the responding probe. The selected probe is indicated when its key is highlighted. At the same time the “Application” fields appear. Upon selection, the programmed “Settings” come into view (8 setting keys for selection of the desired setting).
For starting the system review: Starting the System *(chapter 4.5.1)*.

4.5.1 Starting the System

Touch a setting key.

Touching a setting key causes loading of the preset.
The probe is initialized, the main menu (2D mode) appears on the touchpanel and the ultrasound image appears on the monitor in write mode (real time display).

Pressing the **[Freeze]** key causes loading of the selected (highlighted) setting.
Same function as when pressing a setting key.



Exit: return to the previously used active mode menu (2D mode, M mode, ...) without any changes

Note:
Soft key [Exit] and hard key **[Probe]** provide the same function.
You may exit eventually by one of the keys, if no change of a probe or an application was made.
If a change was made in the "Application" field, the key turns dark (disabled). In this case an exit is only possible by selecting a setting.

4.5.2 To freeze an Image

Freeze/Run-key (hard key)
Storing of the image by pressing the **[Freeze]** key:
Bright key: read mode (image is stored, probe deactivated)
Dark key: write mode (real-time is on, probe activated)

5 Electronic User Manual (EUM) 5-2

5.1 To Exit the Electronic User Manual 5-2

5.2 Navigation Tools 5-3

5.3 Help Book - Navigation Tools 5-4

5.3.1 To View the Contents 5-4

5.3.2 To Use the Index 5-5

5.3.3 To Search for a Topic 5-6

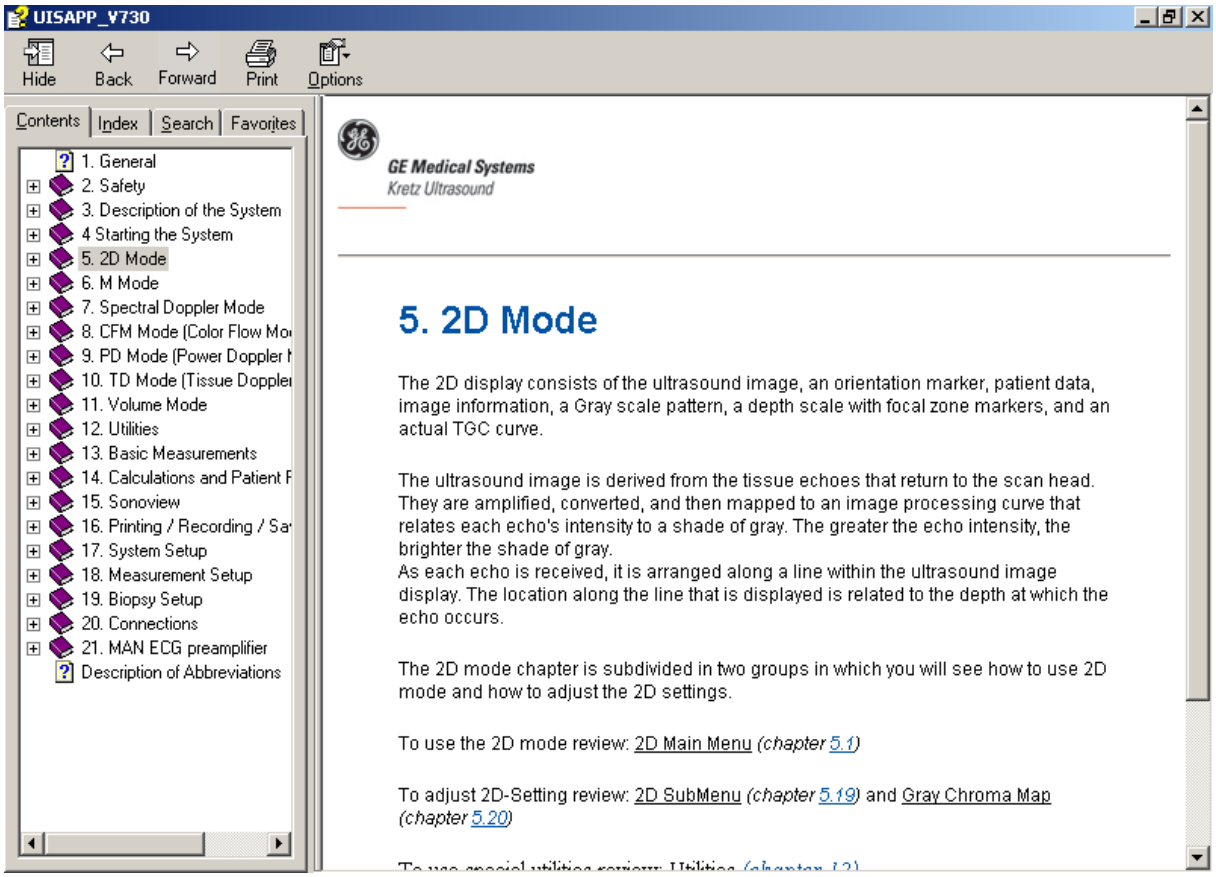
5.3.4 To Save a Favorite Topic 5-7

5 Electronic User Manual (EUM)

F1

Press the **[F1]** key on the keyboard to invoke the electronic user manual.

The EUM screen appears (e.g.: 2D Mode)


UISAPP_V730
Hide
Back
Forward
Print
Options
Contents
Index
Search
Favorites
1. General
2. Safety
3. Description of the System
4 Starting the System
5. 2D Mode
6. M Mode
7. Spectral Doppler Mode
8. CFM Mode (Color Flow Mo
9. PD Mode (Power Doppler
10. TD Mode (Tissue Doppler
11. Volume Mode
12. Utilities
13. Basic Measurements
14. Calculations and Patient
15. Sonoview
16. Printing / Recording / Sa
17. System Setup
18. Measurement Setup
19. Biopsy Setup
20. Connections
21. MAN ECG preamplifier
Description of Abbreviations
GE Medical Systems
Kretz Ultrasound
5. 2D Mode
The 2D display consists of the ultrasound image, an orientation marker, patient data, image information, a Gray scale pattern, a depth scale with focal zone markers, and an actual TGC curve.
The ultrasound image is derived from the tissue echoes that return to the scan head. They are amplified, converted, and then mapped to an image processing curve that relates each echo's intensity to a shade of gray. The greater the echo intensity, the brighter the shade of gray.
As each echo is received, it is arranged along a line within the ultrasound image display. The location along the line that is displayed is related to the depth at which the echo occurs.
The 2D mode chapter is subdivided in two groups in which you will see how to use 2D mode and how to adjust the 2D settings.
To use the 2D mode review: 2D Main Menu (chapter 5.1)
To adjust 2D-Setting review: 2D SubMenu (chapter 5.19) and Gray Chroma Map (chapter 5.20)

The Help screen is divided into three sections:

1. *Navigation Tools* on the top, left portion (Hide, Back, Forward, Print, Options)
2. *Help Book - Navigation Tools* on the left portion of the screen (Contents, Index, Search, Favorites)
3. Content portion on the right side of the screen where help topics are displayed

5.1 To Exit the Electronic User Manual

To exit the electronic user manual, click the [X] symbol on the upper right edge in the Help window.

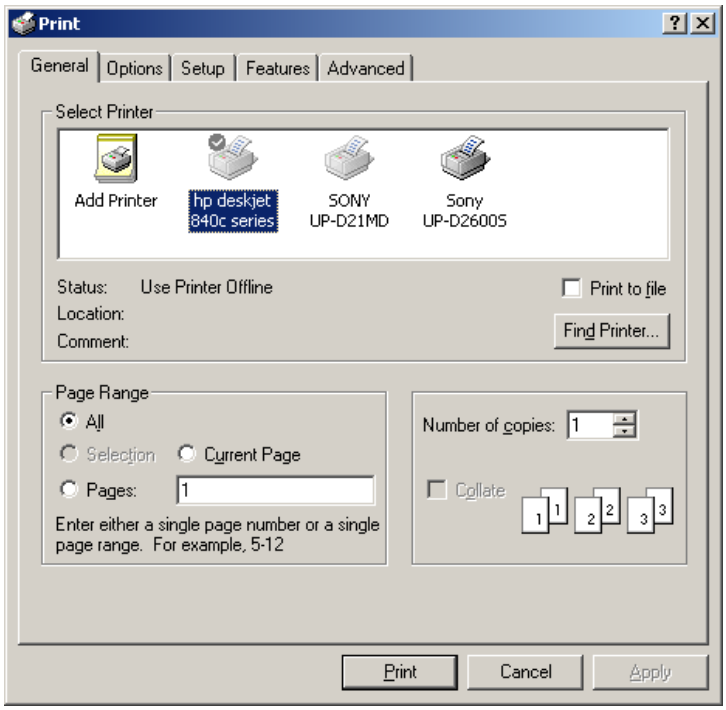
5.2 Navigation Tools

[Hide] the Help book navigation tools on the left portion of the screen.
To view the left side of the screen again, click the [Show] icon.

To go back to the previous selected topic.

To view the topic which was displayed before clicking the [Back] button.

To print the selected topic or the selected heading and all subtopics.



Choose the desired printer, select the “Page Range” and click the [Print] button.

Caution:

Please be aware that changes and modifications, which are not related to installing printers and adjusting printer settings may cause system dysfunction.

Do NOT change the “Default Printer” setting. This will change also the “Report Printer” setting in the System Setup.

To adjust different functions (e.g. Search Highlight ON/OFF).

5.3 Help Book - Navigation Tools

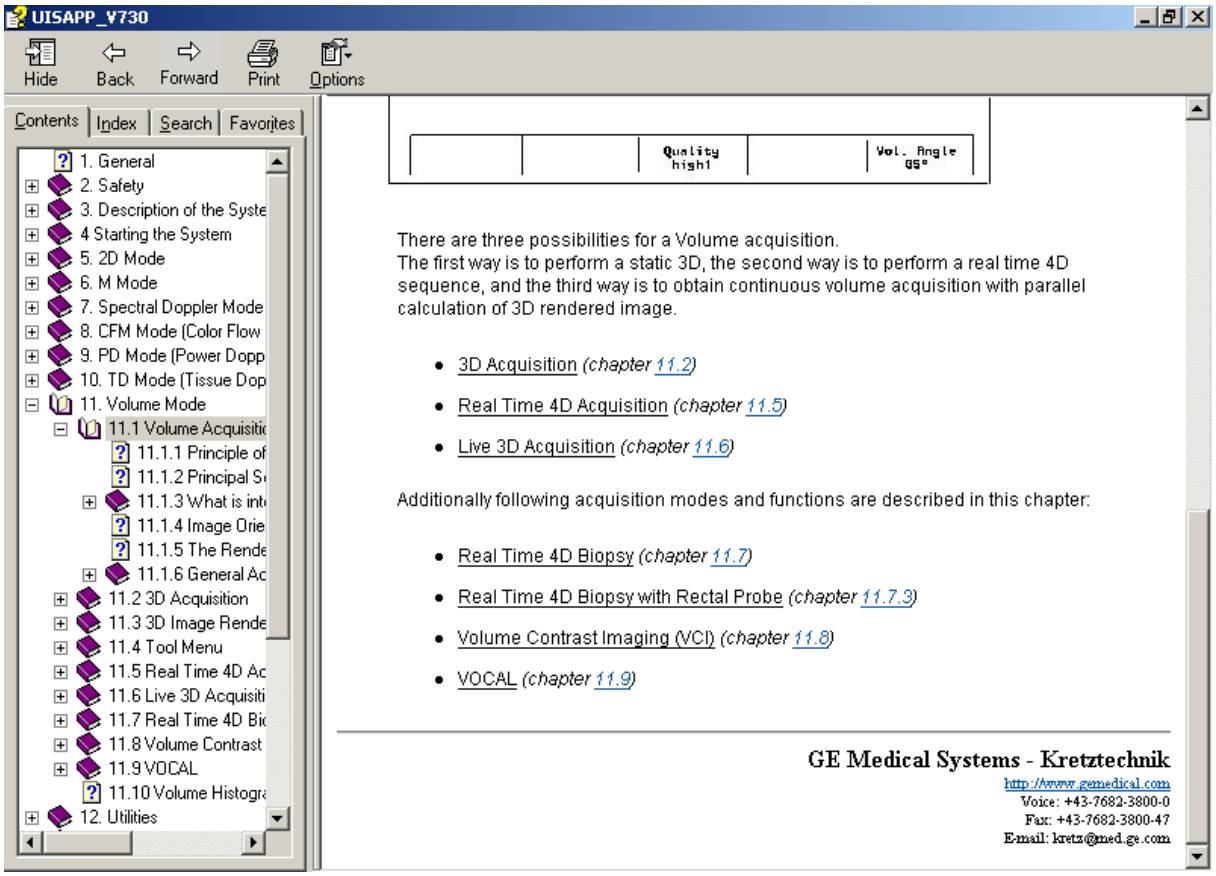
Online Help is organized like a manual, with individual chapters, sections and pages.

Click on the Help book navigation tools on the left portion of the screen:

- To View the Contents *(chapter 5.3.1)*
- To Use the Index *(chapter 5.3.2)*
- To Search for a Topic *(chapter 5.3.3)*
- To Save a Favorite Topic *(chapter 5.3.4)*

5.3.1 To View the Contents

1. Click on the [+] sign next to the chapter you want to view to open up that section.
2. Open up the page to view that page's information.

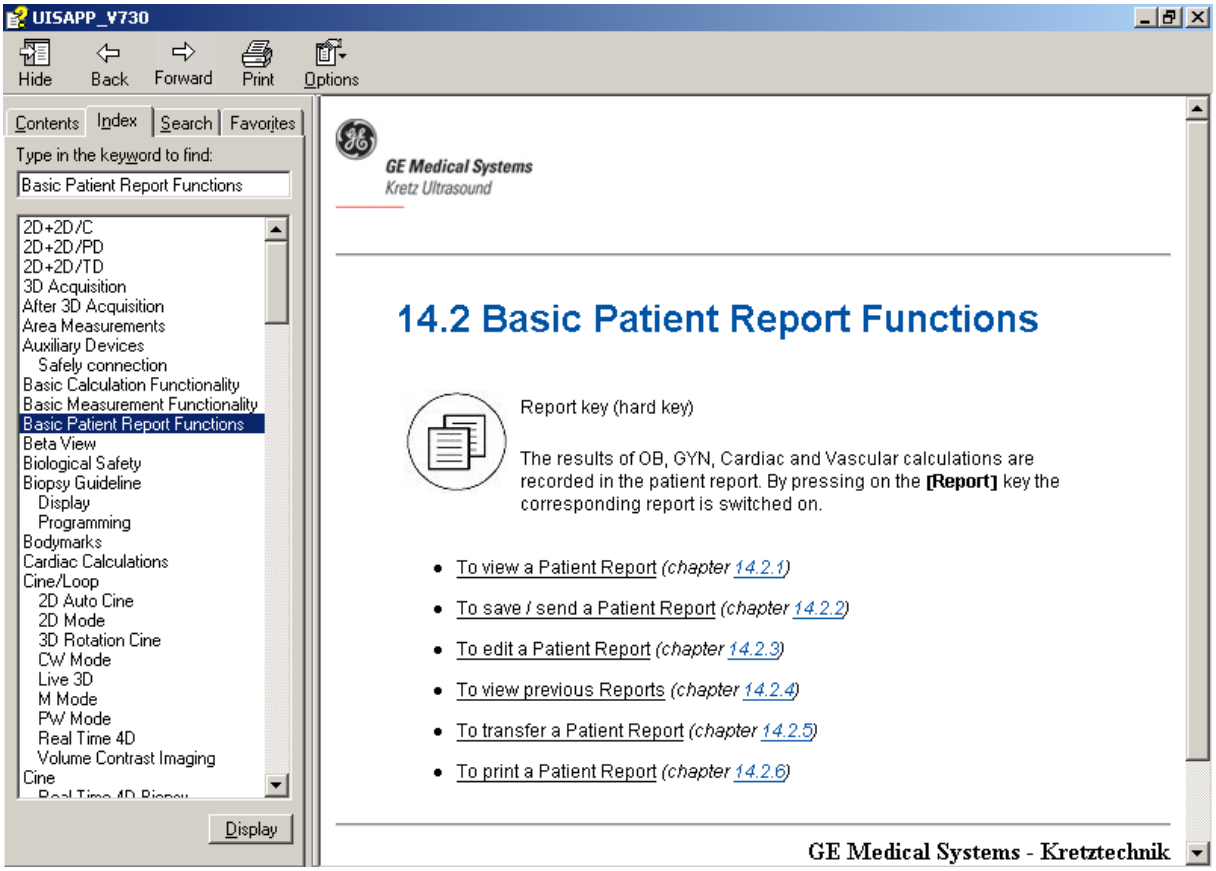

UISAPP_V730
Hide
Back
Forward
Print
Options
Contents
Index
Search
Favorites
1. General
2. Safety
3. Description of the Syste
4 Starting the System
5. 2D Mode
6. M Mode
7. Spectral Doppler Mode
8. CFM Mode (Color Flow
9. PD Mode (Power Dopp
10. TD Mode (Tissue Dop
11. Volume Mode
11.1 Volume Acquisitio
11.1.1 Principle of
11.1.2 Principal S
11.1.3 What is int
11.1.4 Image Orie
11.1.5 The Rende
11.1.6 General Ac
11.2 3D Acquisition
11.3 3D Image Rende
11.4 Tool Menu
11.5 Real Time 4D Ac
11.6 Live 3D Acquisiti
11.7 Real Time 4D Bi
11.8 Volume Contrast
11.9 VOCAL
11.10 Volume Histogr
12. Utilities
Quality high1
Vol. Angle 85°
There are three possibilities for a Volume acquisition.
The first way is to perform a static 3D, the second way is to perform a real time 4D sequence, and the third way is to obtain continuous volume acquisition with parallel calculation of 3D rendered image.
3D Acquisition (chapter 11.2)
Real Time 4D Acquisition (chapter 11.5)
Live 3D Acquisition (chapter 11.6)
Additionally following acquisition modes and functions are described in this chapter:
Real Time 4D Biopsy (chapter 11.7)
Real Time 4D Biopsy with Rectal Probe (chapter 11.7.3)
Volume Contrast Imaging (VCI) (chapter 11.8)
VOCAL (chapter 11.9)
GE Medical Systems - Kretztechnik
http://www.gemedical.com
Voice: +43-7682-3800-0
Fax: +43-7682-3800-47
E-mail: kretz@med.ge.com

The blue, underlined text links you to related topics.

After you click on the blue, underline text, the screen updates with this link's content.
To return to the previous screen click [Back]. To return to the link, click [Forward].

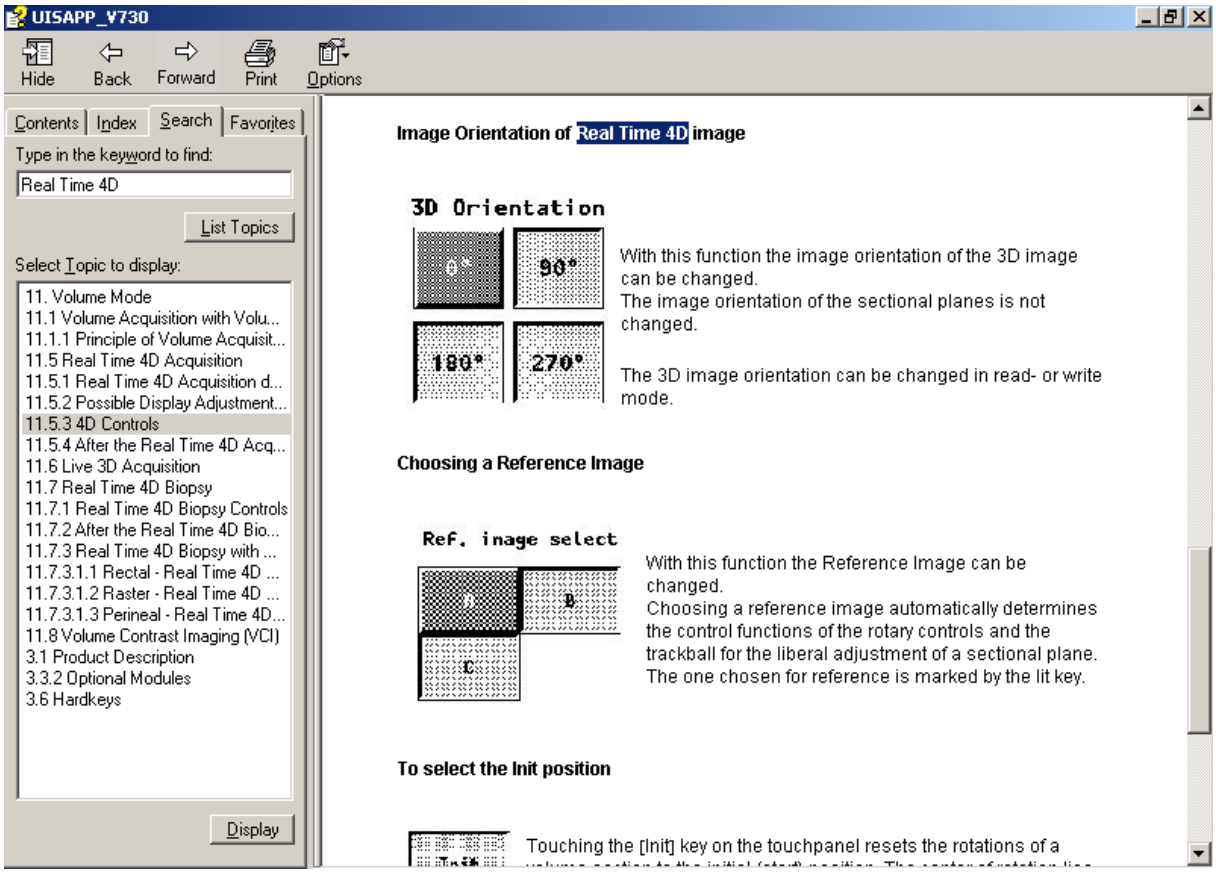
5.3.2 To Use the Index

1. Click on the “Index” tab. A list of topics - arranged in alphabetical order - will be displayed.
2. Use the scroll bar to look up a topic.
3. Either double click the desired topic to view, or highlight the topic and click the [Display] button.



5.3.3 To Search for a Topic

1. To search for a specific topic, click on the “Search” tab.
2. Type in the topic name in the *Type in the keyword to find:* field.
   Topics with the word or phrase you typed appear in the *Select Topic to display:* area.
3. Either double click the desired topic to view, or highlight the topic and click the [Display] button.

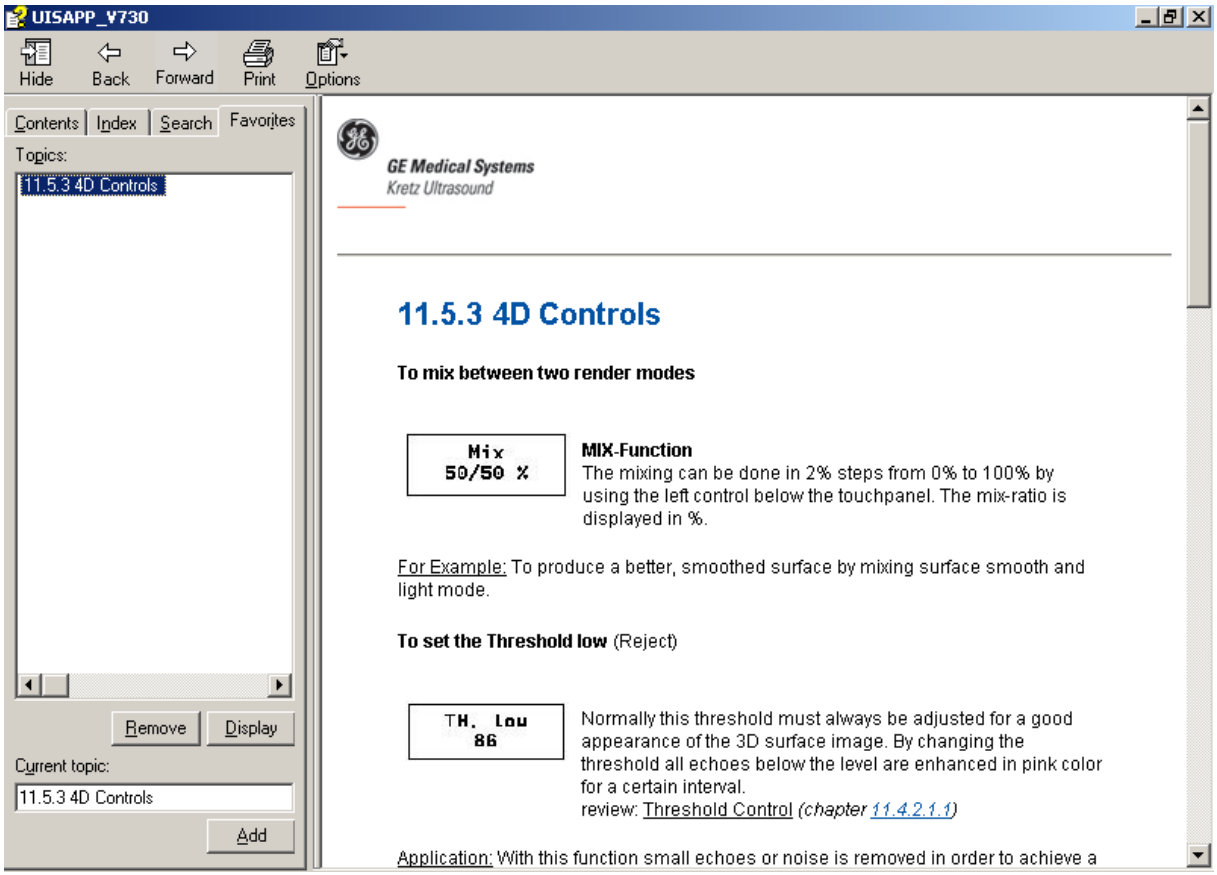

UISAPP_V730
Hide
Back
Forward
Print
Options
Contents
Index
Search
Favorites
Type in the keyword to find:
Real Time 4D
List Topics
Select Topic to display:
11. Volume Mode
11.1 Volume Acquisition with Volu...
11.1.1 Principle of Volume Acquisit...
11.5 Real Time 4D Acquisition
11.5.1 Real Time 4D Acquisition d...
11.5.2 Possible Display Adjustment...
11.5.3 4D Controls
11.5.4 After the Real Time 4D Acq...
11.6 Live 3D Acquisition
11.7 Real Time 4D Biopsy
11.7.1 Real Time 4D Biopsy Controls
11.7.2 After the Real Time 4D Bio...
11.7.3 Real Time 4D Biopsy with ...
11.7.3.1.1 Rectal - Real Time 4D ...
11.7.3.1.2 Raster - Real Time 4D ...
11.7.3.1.3 Perineal - Real Time 4D...
11.8 Volume Contrast Imaging (VCI)
3.1 Product Description
3.3.2 Optional Modules
3.6 Hardkeys
Display
Image Orientation of Real Time 4D image
3D Orientation
0°
90°
180°
270°
With this function the image orientation of the 3D image can be changed.
The image orientation of the sectional planes is not changed.
The 3D image orientation can be changed in read- or write mode.
Choosing a Reference Image
Ref. image select
A
B
C
With this function the Reference Image can be changed.
Choosing a reference image automatically determines the control functions of the rotary controls and the trackball for the liberal adjustment of a sectional plane.
The one chosen for reference is marked by the lit key.
To select the Init position
Touching the [Init] key on the touchpanel resets the rotations of a

5.3.4 To Save a Favorite Topic

You may find that there are topics you need to refer to often. In this case, it is a good idea to save these topics as Favorites.

1. To save a topic as a favorite, click on the “Favorites” tab.
2. Highlight the topic in the *Topics:* field and click the [Add] button.

You can now view this topic quickly by going to the Favorites help tab.


UISAPP_V730
Hide
Back
Forward
Print
Options
Contents
Index
Search
Favorites
Topics:
11.5.3 4D Controls
Remove
Display
Current topic:
11.5.3 4D Controls
Add
GE Medical Systems
Kretz Ultrasound
11.5.3 4D Controls
To mix between two render modes
Mix
50/50 %
MIX-Function
The mixing can be done in 2% steps from 0% to 100% by using the left control below the touchpanel. The mix-ratio is displayed in %.
For Example: To produce a better, smoothed surface by mixing surface smooth and light mode.
To set the Threshold low (Reject)
TH. Lou
86
Normally this threshold must always be adjusted for a good appearance of the 3D surface image. By changing the threshold all echoes below the level are enhanced in pink color for a certain interval.
review: Threshold Control (chapter 11.4.2.1.1)
Application: With this function small echoes or noise is removed in order to achieve a

This page intentionally left blank.

6. Connections 6-2

6.1 How to connect Auxiliary Devices safely 6-2

6.2 To Connect internal and external Accessories 6-3

6.2.1 Main Module 6-4
6.2.2 Power Supply (rear Side) 6-6
6.2.3 Power Supply (for Auxiliary Equipments) 6-7
6.2.4 Side of the Main Module-Connectors 6-8
6.2.5 Connector Panel (rear Side) 6-9
6.2.6 Color Video Monitor Connection 6-10
6.2.7 B/W Video Printer Connection Scheme 6-11
6.2.8 S-VHS Videorecorder Connection Scheme 6-12
6.2.9 Color Video Printer Connection Scheme 6-13
6.2.9.1 Sony UP-D2600S 6-13
6.2.9.2 Sony UP-D21MD 6-14
6.2.9.3 Mitsubishi CP770DW 6-15
6.2.10 Line Printer Connection Scheme 6-16
6.2.11 ECG-preamplifier (MAN 6) Connection 6-17
6.2.12 Foot Switch (MFT 7) Connection 6-18

6.3 Important Notes: Connecting Auxiliary Equipment 6-19

6. Connections

6.1 How to connect Auxiliary Devices safely

Basic Concept:

The Voluson® 730 is equipped with an isolation transformer to provide the required separation from mains for both the system and auxiliary devices. These mains outlets are accessible at the rear of the unit after removing the rear panel.

Video Copy Processor (VCP), Video tape recorders (VTR) are to be connected here as described in chapter Connections.

The Voluson® 730 provides several inputs and outputs (I/O) such as Audio, Video, Ethernet, USB, DICOM and Printer signals. Special care has to be taken when connecting these signals to other devices.

The IEC 60601-1-1 standard provides a guideline for safely interconnecting medical devices in systems.

“Equipment connected to the analog or digital interface must comply with the respective IEC/UL standards (e.g. IEC 950/UL 1950 for data processing equipment and IEC 60601-1/ UL 2601-1 for medical equipment). Furthermore all configurations shall comply with the system standard IEC 60601-1-1. Everybody who connects additional equipment to the signal input part or signal output part configures a medical system, and is therefore responsible that the system complies with the requirements of the system standard IEC 60601-1-1. If in doubt, consult the technical service department or your local representative.”

1.) The medical device may be connected to a single IEC XXX device (protection class I) placed in a room which is not medically used.

2.) If the device is to be connected in a medically used room the following rule applies:

a.) IEC 60601 compliant devices may be connected as such.
b.) IEC XXX compliant devices (protection class I) may be connected with an additional safety measure.

For all situations 1 and 2, the additional device shall be installed outside the patient environment.

Additional protective earth connection between the 2 devices,
or a safety isolation mains transformer for the other device

Special care has to be taken, if the device is connected to computer network (e.g., Ethernet), because other devices could be connected without any control. There could be a potential difference between the protective earth and any line of the computer network including the shield.

In this case the only way to operate the system safely is to use an isolated signal link with minimum 4mm creepage distance, 2.5mm air clearance of the isolation device. For computer networks there are media converters available which convert the electrical to optical signals. Please consider that this converter has to comply with IEC xxx standards and is battery operated or connected to the isolated mains output of the Voluson® 730. review: Connector Panel (rear Side) *(chapter 6.2.5)*

Additionally the IEC60601-1-1 requires control measurement of leakage currents.

The system integrator (any person connecting the medical device to other devices) is responsible that the connections are safe.

IEC XXX	Stands for standards such as :	IEC 60601 for medical devices IEC 950 for information technology equipment etc.

6.2 To Connect internal and external Accessories

review:

Main Module *(chapter 6.2.1)*

Power Supply (rear Side) *(chapter 6.2.2)*

Power Supply (for Auxiliary Equipments) *(chapter 6.2.3)*

Side of the Main Module-Connectors *(chapter 6.2.4)*

Connector Panel (rear Side) *(chapter 6.2.5)*

Color Video Monitor Connection *(chapter 6.2.6)*

B/W Video Printer Connection Scheme *(chapter 6.2.7)*

S-VHS Videorecorder Connection Scheme *(chapter 6.2.8)*

Color Video Printer Connection Scheme *(chapter 6.2.9)*

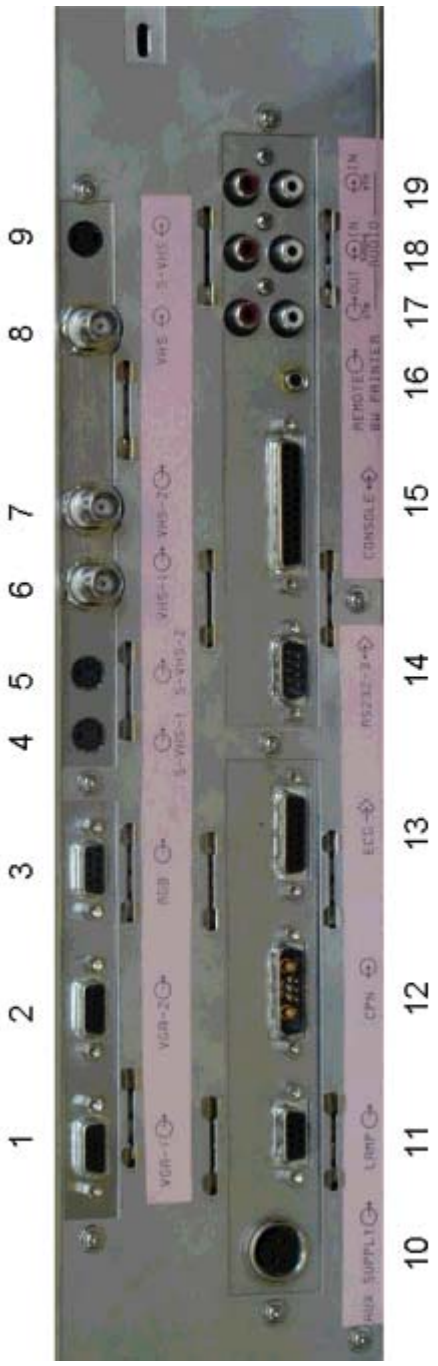
Line Printer Connection Scheme *(chapter 6.2.10)*

ECG-preamplifier (MAN 6) Connection *(chapter 6.2.11)*

Foot Switch (MFT 7) Connection *(chapter 6.2.12)*

Important Notes: Connecting Auxiliary Equipment *(chapter 6.3)*

6.2.1 Main Module



1 **VGA 1**
Connector for the internal color video monitor

2 **VGA 2**
Connector for an external color monitor

3 **R, G, B, H, V outputs for color video printer**

Pin 1 : Red
2 : Green
3 : Blue
4 : Composite Sync
5 : V-Sync

4 **S-VHS 1 OUT**

5 **S-VHS 2 OUT**

6 **Video out:** $1V_{SS}$ @ 75 Ohm, PAL
$1V_{SS}$ @ 75 Ohm, NTSC

7 **Video out:** $1V_{SS}$ @ 75 Ohm, CCIR
$1V_{SS}$ @ 75 Ohm, FCC

8 **Video in:** $1V_{SS}$ @ 75 Ohm, PAL / CCIR
$1V_{SS}$ @ 75 Ohm, NTSC / FCC

9 **S-VHS IN**

10 **Power Supply for Module GEM 1**

11 **Connector for external lamp**

12 **Power supply input**

13 **Connector for MAN** (ECG-preamplifier)

14 **RS232 (2)**

15 **Connector for console**

16 **Remote control B/W-Printer**

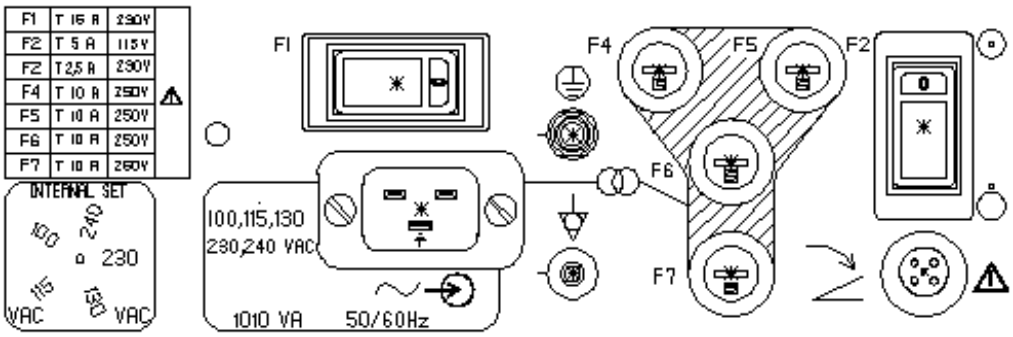
17 **Audio OUT R/L-VTR**

18 **Audio IN R/L-SOUND**

19 **Audio IN R/L-VTR**

review also: Technical data/ Information: Interfaces *(chapter 7.16)*,
or *(chapter 22.16)* of the Basic User Manual for Voluson 730.

6.2.2 Power Supply (rear Side)



F1 **Mains Switch:** Thermal Circuitbreaker T 16 Ampere /230V reusable
Manufacturer: E-T-A® Type: 3120-F521-P7TI-W01A 16A

Mains IN Mains voltage according to type plate
Modification of voltage setting only by authorized service person!
Possible mains voltages: 100V, 115V, 130V, 230V, 240V, AC only

F4, F5, F6, F7: T 10 Ampere /250V fuse Type: H (high breaking capacity)
Manufacturer: Schurter order Nr. 0001.2534 Type SPT

F2 **On-switch for auxiliary devices:**
Thermal Circuitbreaker T 2.5 Ampere / 230V reusable
T 5 Ampere / 115 V reusable
Manufacturer: E-T-A® Type: 3120-F521-P7TI-W01A-X017 2.5/5A

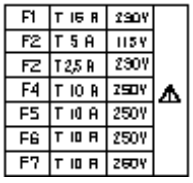
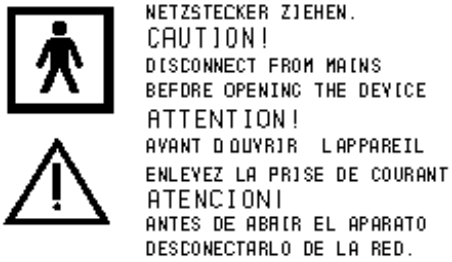


Table for the Fuses used.



Potential equilibrium connection (rear panel)

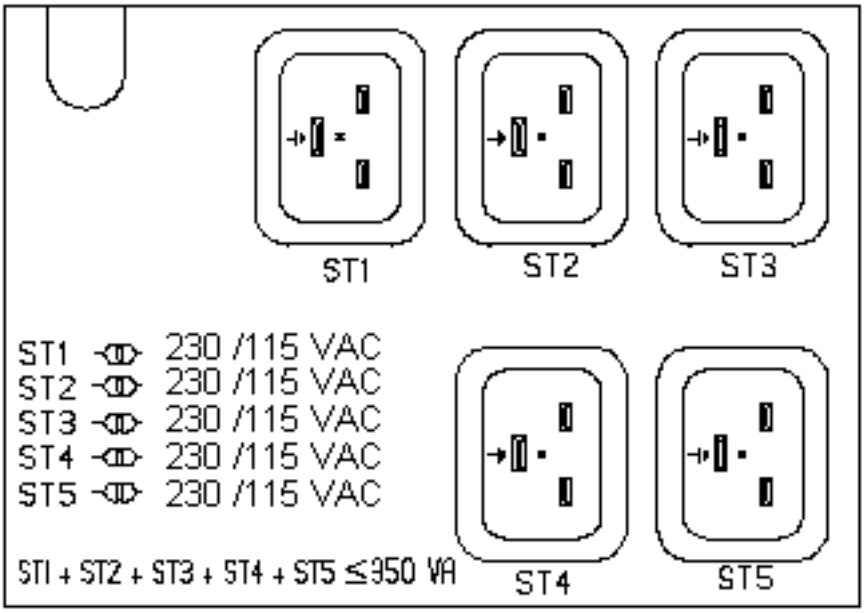
Protective earth connection

Information plate for the adjusted voltage setting.
Modification of voltage setting only by authorized service person!
Possible mains voltages: 100V, 115V, 130V, 230V, 240V, AC only

Connector for Foot Switch
review also: Important Instructions for Safety *(chapter 2.1)*.
To adjust the Foot Switch review: System Setup: Peripherals *(chapter 17.3.3)*.

6.2.3 Power Supply (for Auxiliary Equipments)

For auxiliary equipment



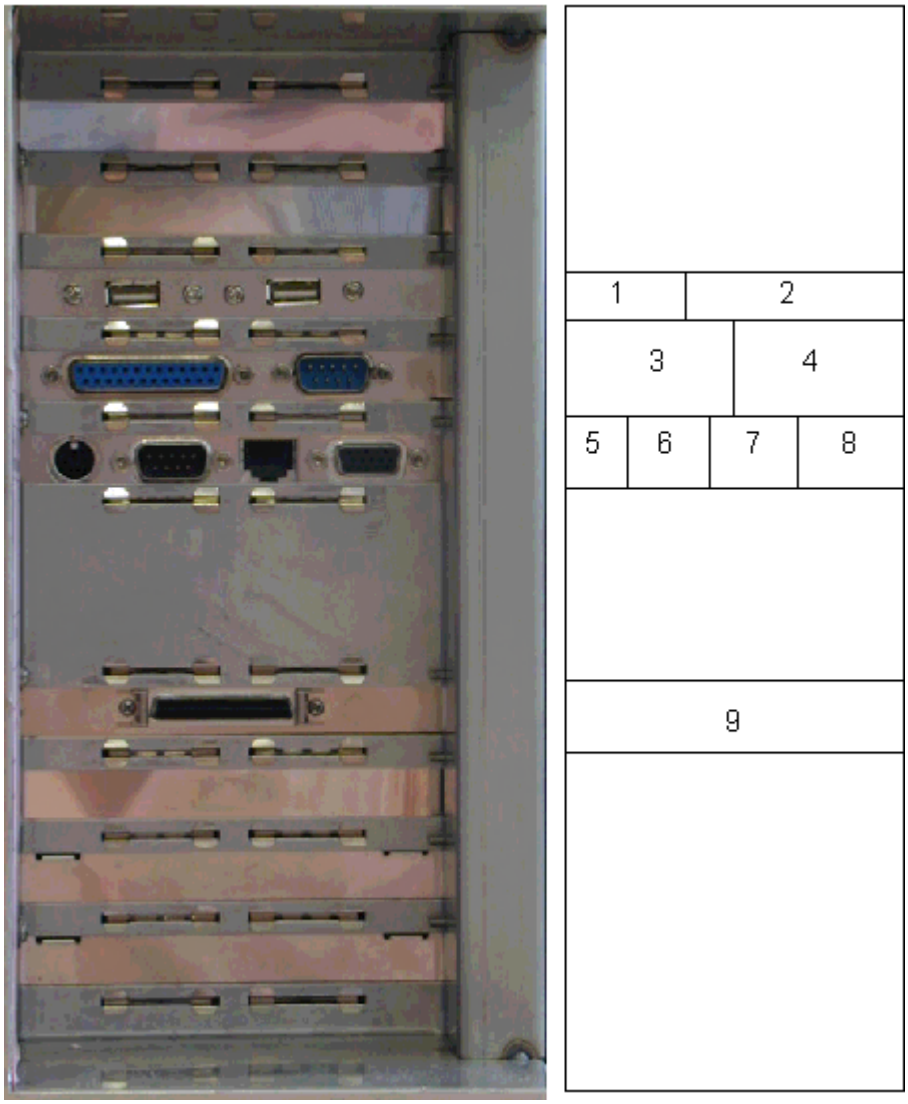
ST1-ST5 Mains OUT for auxiliary equipment

These outlets are fed from an isolation transformer which is switched with the F2 switch of the rear side. This outlet voltage is not depending on the mains voltage.

CAUTION! The sum of the power consumption of equipment connected to these outlets must not exceed 350 VA (incl. the color video monitor)!

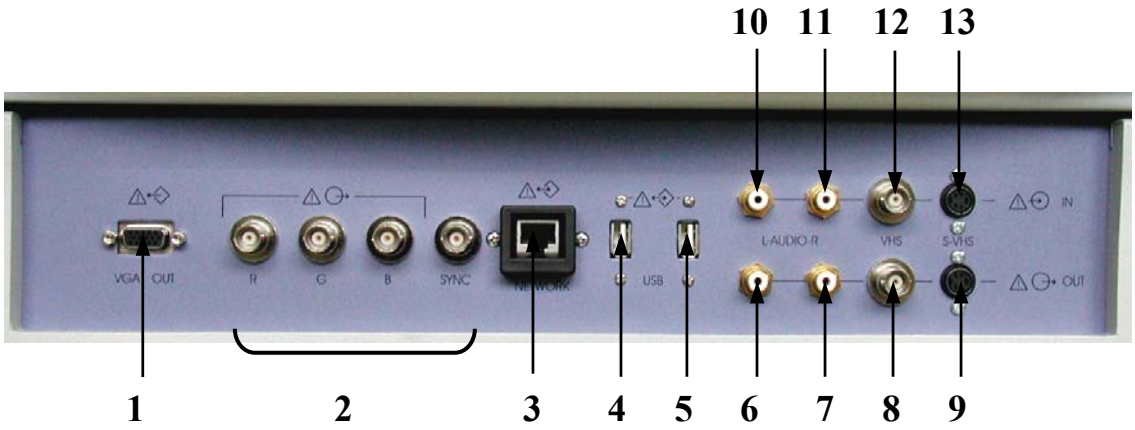
CAUTION: The outlets ST1 – ST5 may be set to 230V or 115V
Modification of voltage setting only by an authorized service person!

6.2.4 Side of the Main Module-Connectors



1 **USB-1 PORT Connector**
2 **USB-2 PORT Connector**
3 **Parallel port for PC-LINE PRINTER**
4 **RS232-2 (no function)**
5 **Connector for MOUSE/KEYBOARD**
6 **RS232-1 Connector for OPERATION PANEL**
7 **Connector for NETWORK twisted pair RJ-45 10/100 megabit/s**
8 **VGA (no function)**
9 **AUXILIARY SCSI**

6.2.5 Connector Panel (rear Side)



1 **VGA (OUTPUT) - print out VGA signal with monitor/printer**

2 **R, G, B, H/V SYNC - outputs for color video printer/monitor**

3 **NETWORK - DICOM input/output twisted pair RJ-45 10/100 megabit/s**
review: How to Connect Auxiliary Devices Safely *(chapter 6.1)*

4 **USB-1 – USB port**

5 **USB-2 – USB port**

6 **AUDIO LEFT OUT**

7 **AUDIO RIGHT OUT**

8 **VHS OUT**

9 **S-VHS OUT**

10 **AUDIO LEFT IN**

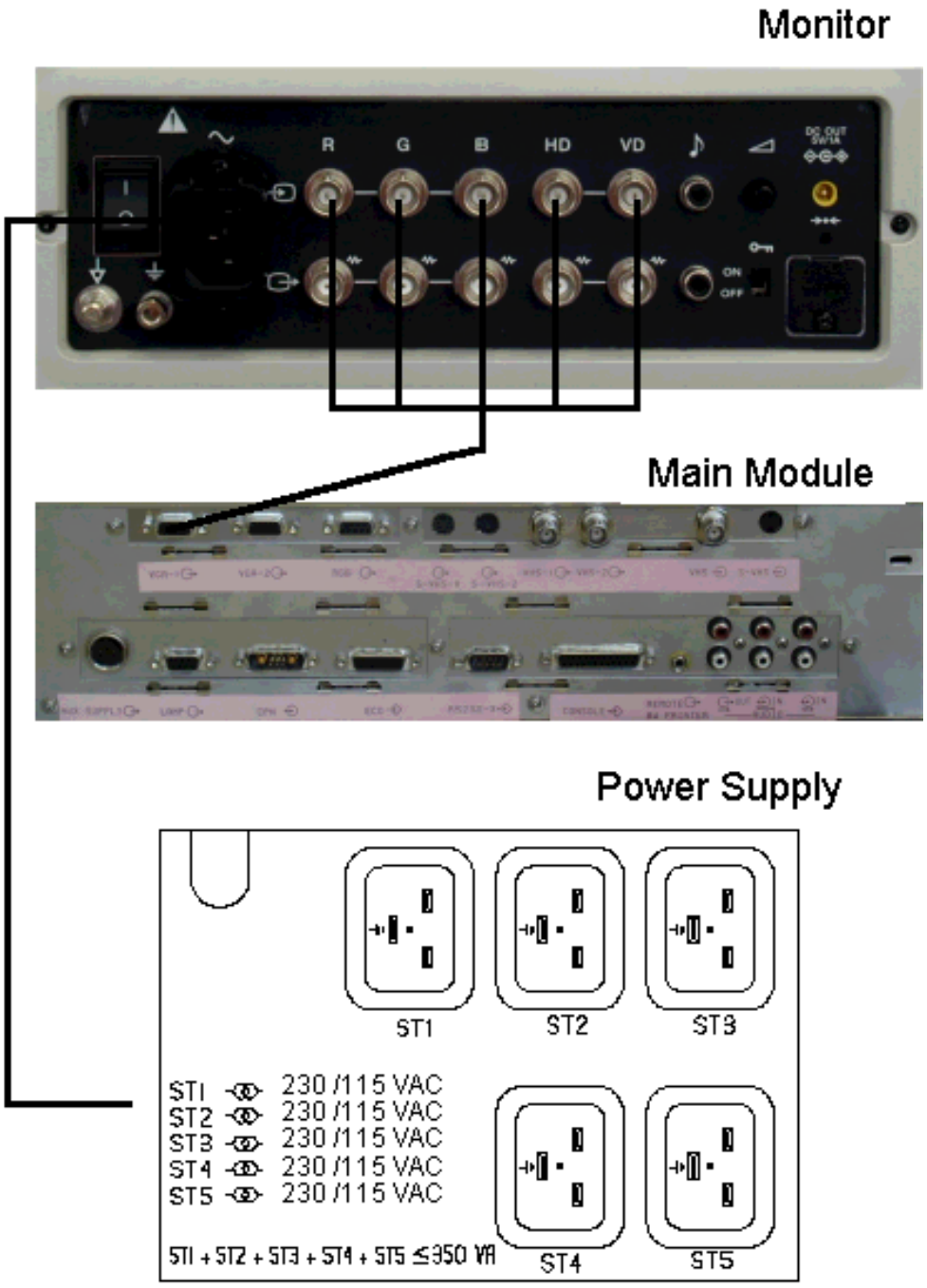
11 **AUDIO RIGHT IN**

12 **VHS IN**

13 **S-VHS IN**

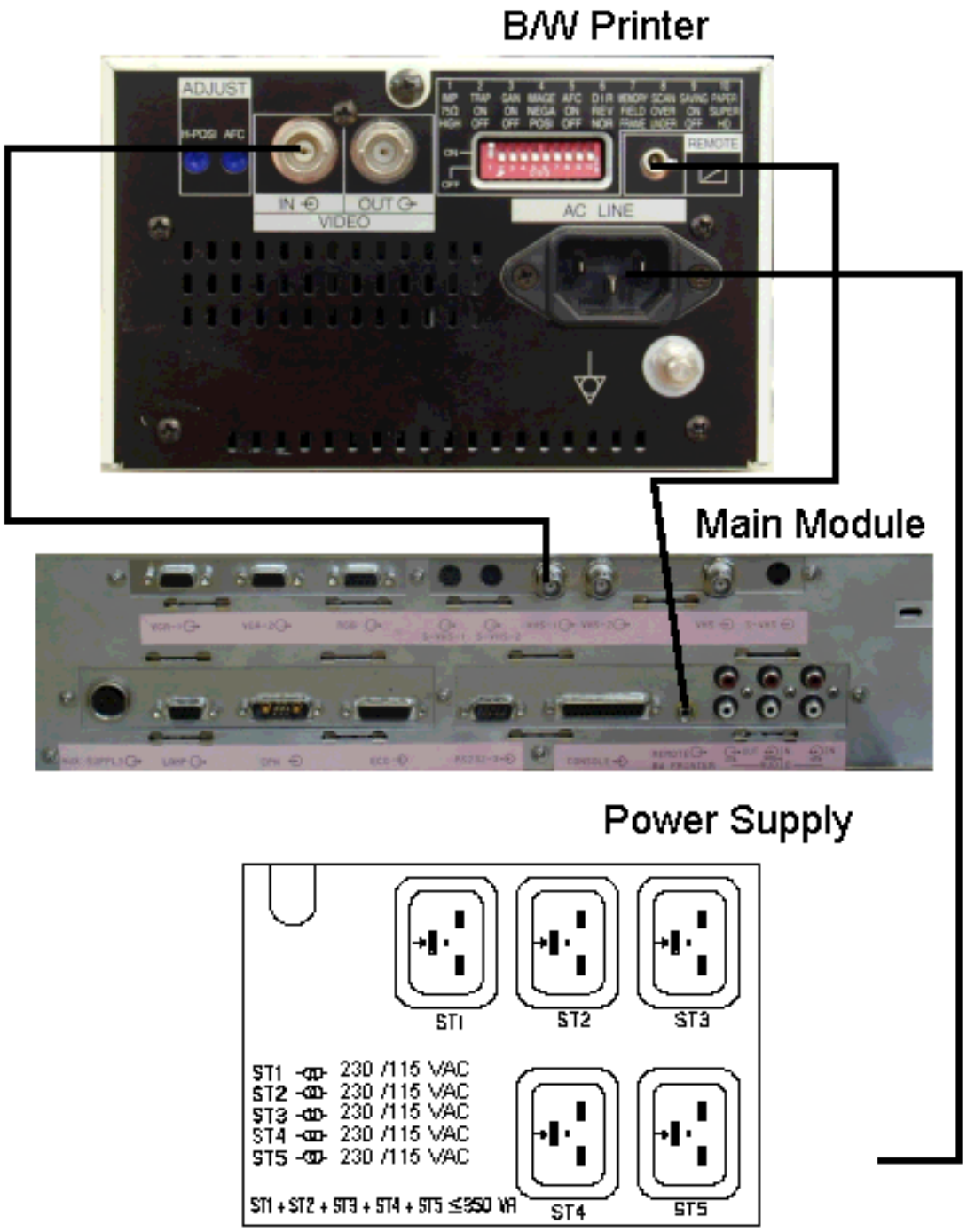
review also: Technical data/ Information: Interfaces *(chapter 7.16)*,
or *(chapter 22.16)* of the Basic User Manual for Voluson 730.

6.2.6 Color Video Monitor Connection



CAUTION: **The outlets ST1 – ST5 may be set to 230V or 115V**
Modification of voltage setting only by an authorized service person!

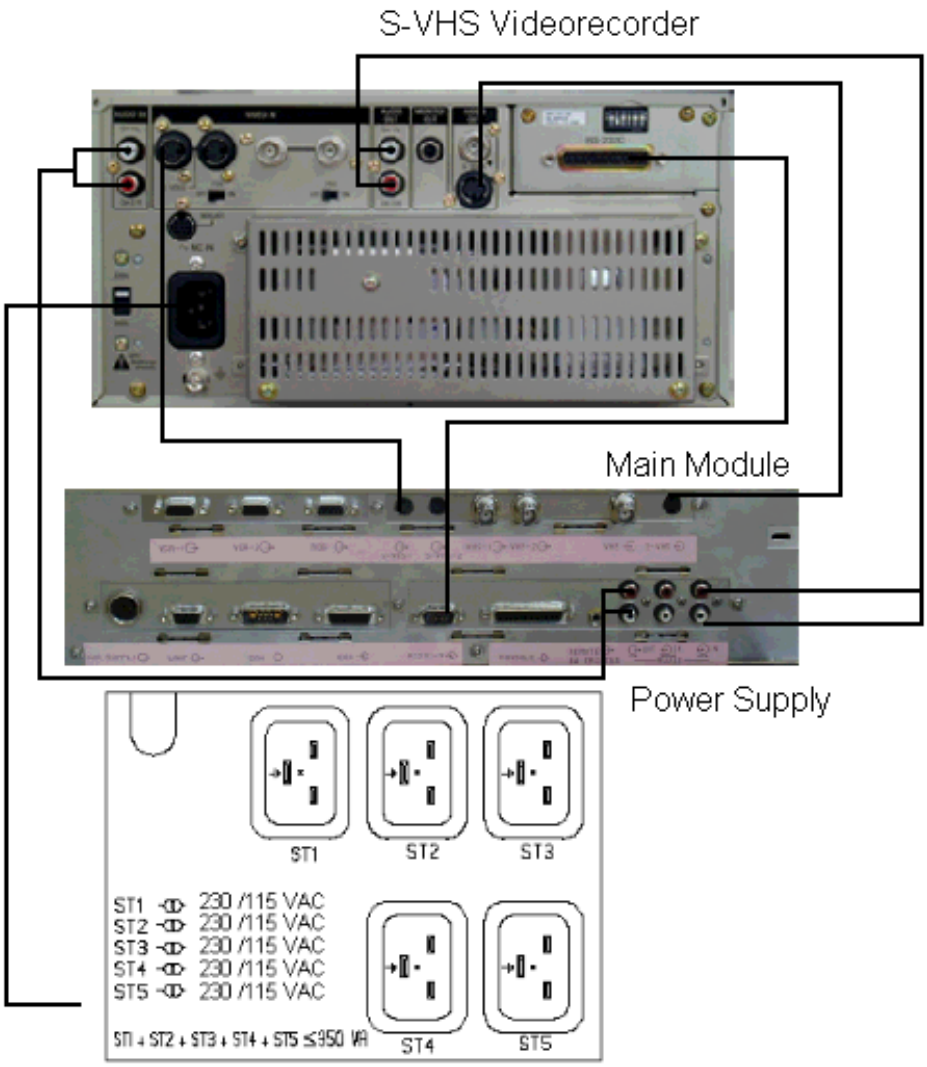
6.2.7 B/W Video Printer Connection Scheme
(Mitsubishi P91E B/W / Sony UP 895 CE B/W

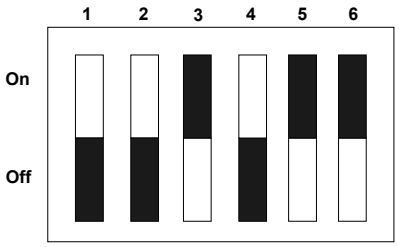


CAUTION: **The outlets ST1 – ST5 may be set to 230V or 115V**
Modification of voltage setting only by an authorized service person!

REMARK: **Please use: Connection set PPP55**

6.2.8 S-VHS Videorecorder Connection Scheme
(Sony SVO-9500MDP)





Set DIP Switches on RS 232C interface board as shown:

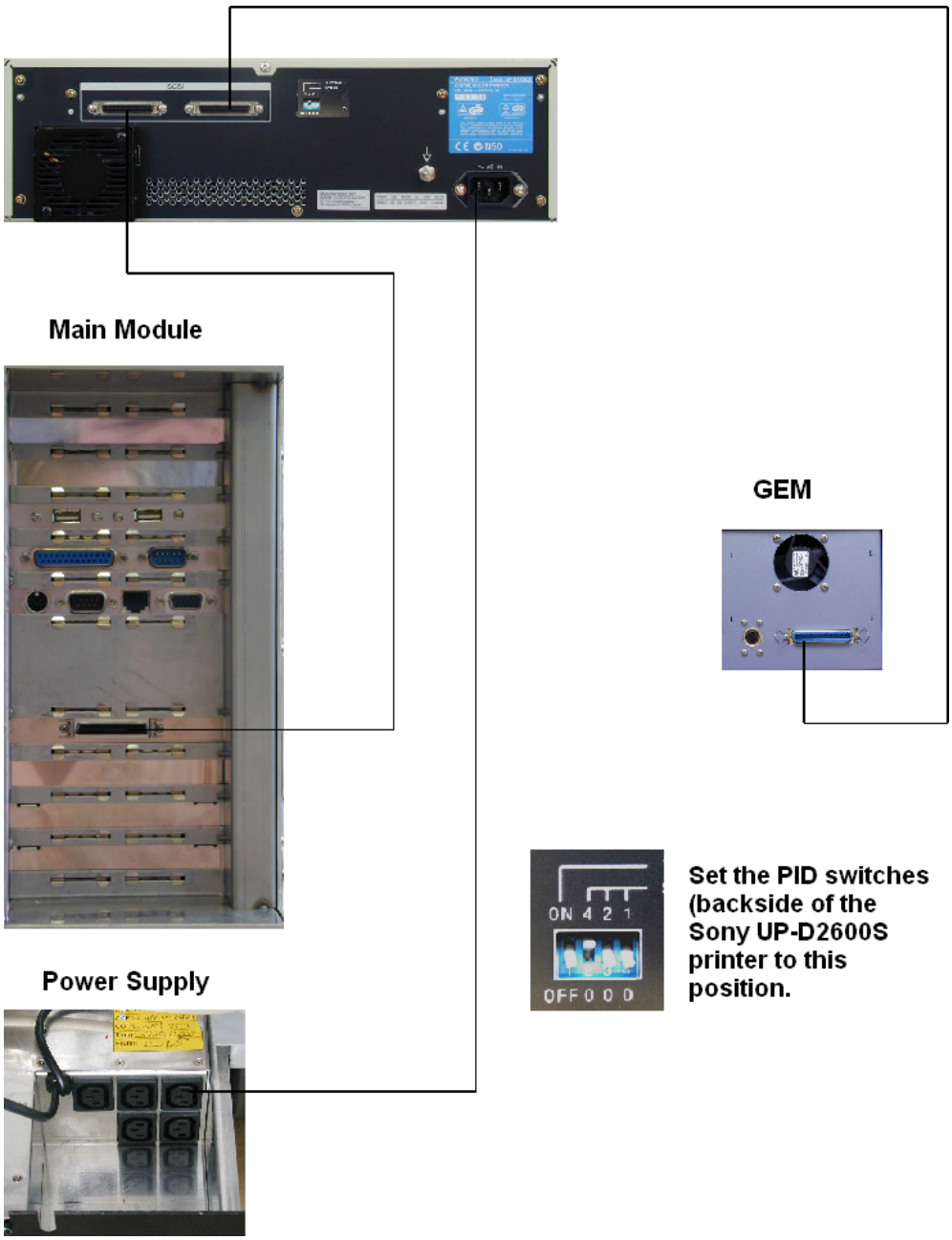
Switch 1:	OFF-Audio is muted during fast playback
Switch 2:	OFF-FF/REW mode is used during searches.
Switch 3:	ON-VCR counter is reset upon cassette ejection.
Switch 4:	OFF-The VCR can be controlled by the V730.
Switch 5 + 6:	ON-The Baud rate is set to 19200 bit/sec (must be the same as V730)

CAUTION: **The outlets ST1 – ST5 may be set to 230V or 115V**
Modification of voltage setting only by an authorized service person!

REMARKS: **Please use:** **Connection set PRR50**
Remote cable KUG5

6.2.9 Color Video Printer Connection Scheme

6.2.9.1 Sony UP-D2600S

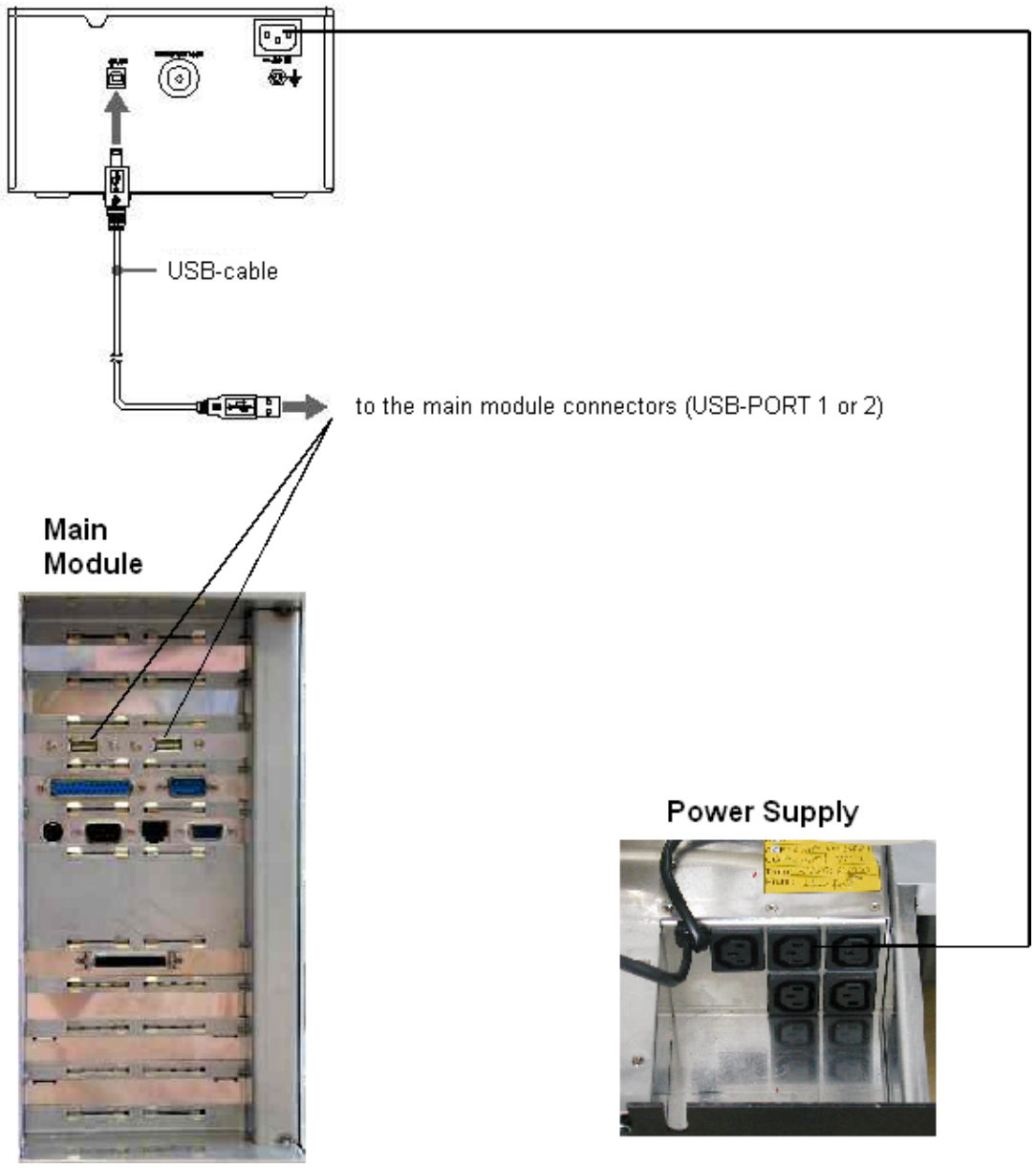


CAUTION: **The outlets ST1 – ST5 may be set to 230V or 115V**
Modification of voltage setting only by an authorized service person!

REMARK: **Please use: Connection set PZP50**

NOTE: **The switch of the printer has to be in ON position before starting the system.**
Leave printer switch always ON.

6.2.9.2 Sony UP-D21MD



CAUTION: **The outlets ST1 – ST5 may be set to 230V or 115V**
Modification of voltage setting only by an authorized service person!

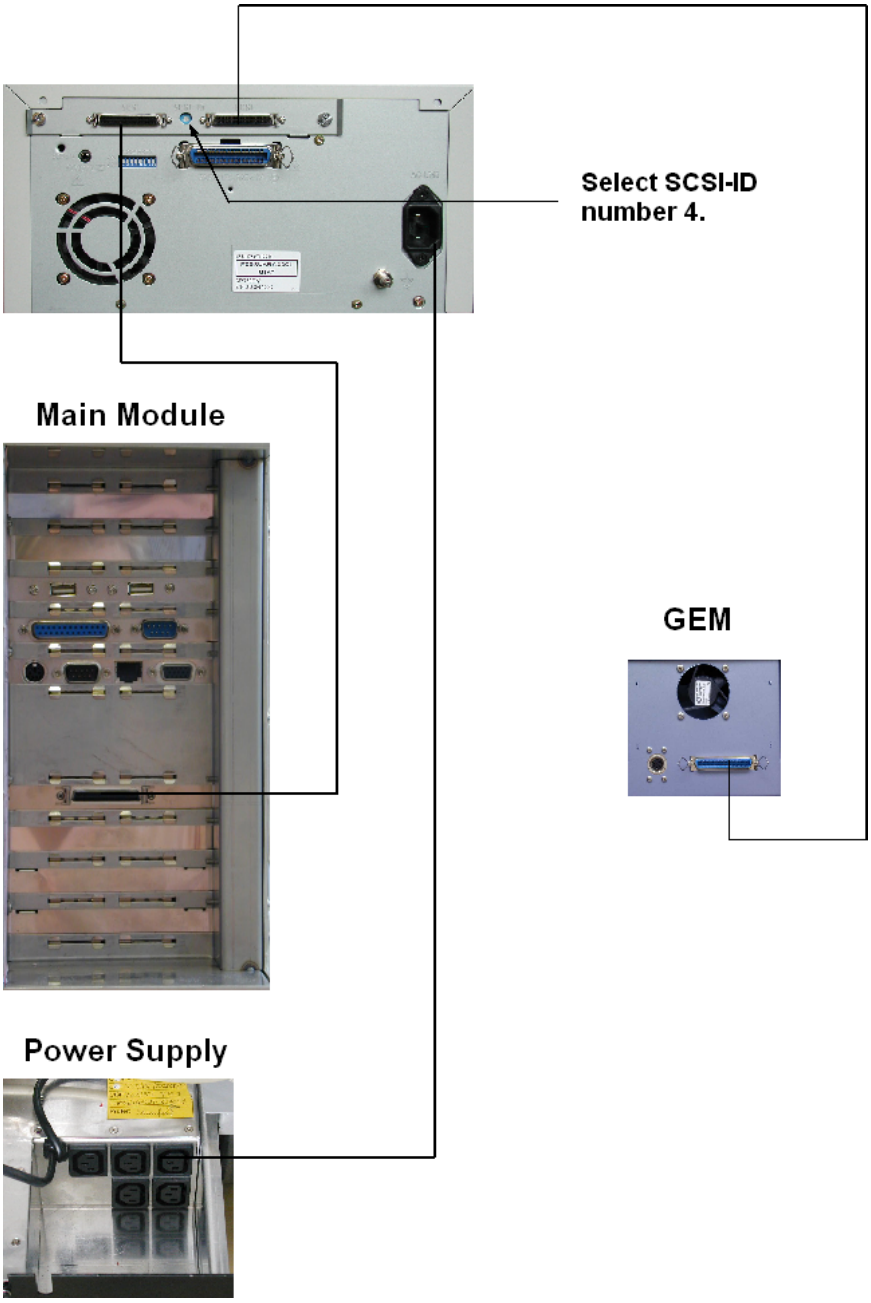
CAUTION: **Pay attention to lateral distances. See Instruction Manual of the Sony printer!!!**

CAUTION: **The Printer Supply Voltage must be the same as Output Voltage of Voluson730 Power Out Connectors (Power Supply)!**

REMARK: **Please use: Connection set PZP60**

NOTE: **The switch of the printer has to be in ON position before starting the system. Leave printer switch always in the ON position.**

6.2.9.3 Mitsubishi CP770DW

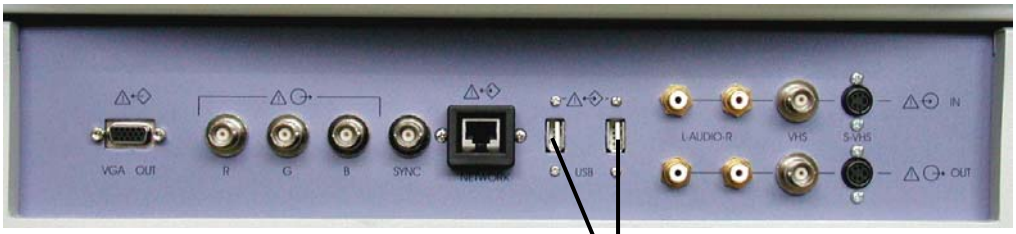


CAUTION: **The outlets ST1 – ST5 may be set to 230V or 115V**
Modification of voltage setting only by an authorized service person!

REMARK: **Please use: Connection set PZP50**

NOTE: **The switch of the printer has to be in ON position before starting the system.**
Leave printer switch always in the ON position.

6.2.10 Line Printer Connection Scheme
(HP deskjet 990cxi or HP deskjet 995c)

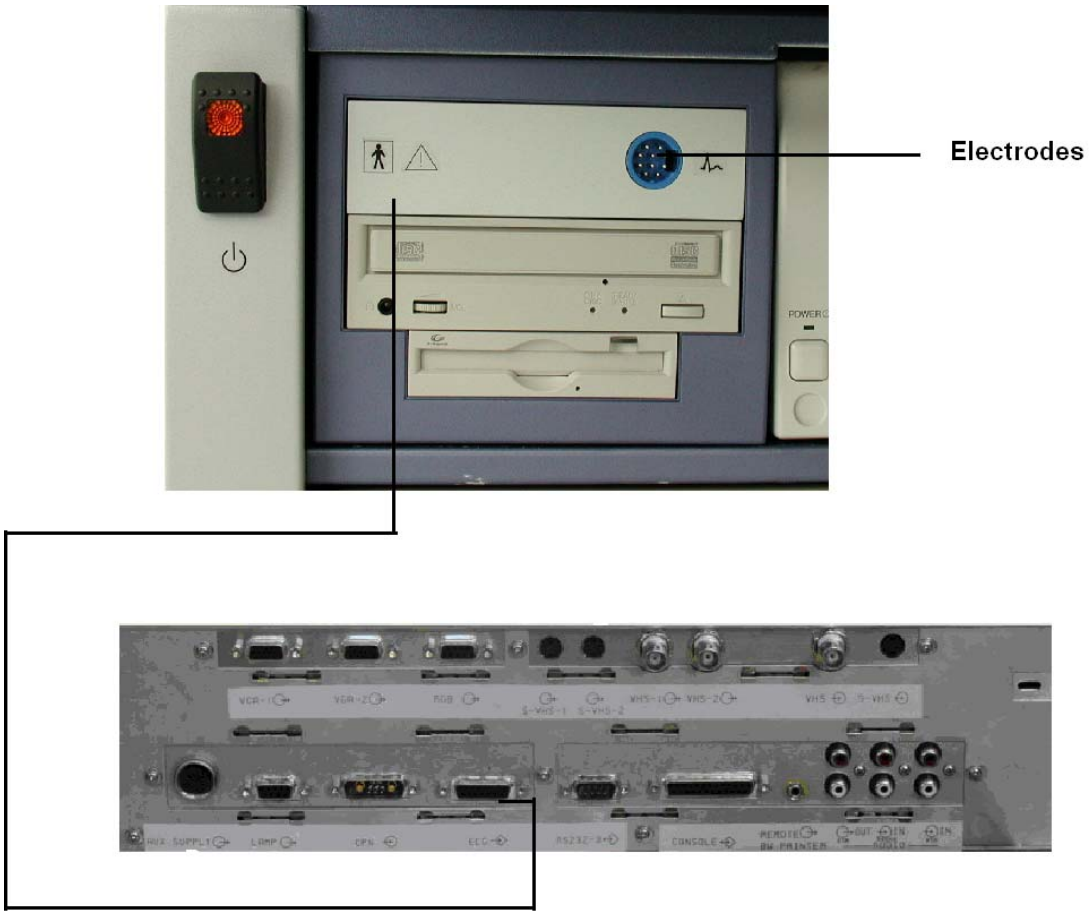


CAUTION: **Please observe that the Line Printer type HP 990cxi / HP 995c has to be located outside of the patient environment (acc. IEC 60601-1 / UL 2601-1).**

REMARK: **Please use:** **Connection set PZP55 for HP 990cxi**
Connection set PZP56 for HP 995c

NOTE: **The switch of the printer has to be in ON position before starting the system. Leave printer switch always in the ON position.**

6.2.11 ECG-preamplifier (MAN 6) Connection



6.2.12 Foot Switch (MFT 7) Connection

To adjust the Foot Switch review: System Setup: Peripherals *(chapter 17.3.3)* of the Basic User Manual for Voluson 730.

6.3 Important Notes: Connecting Auxiliary Equipment

CAUTION ! **The leakage current of the entire system including any / all auxiliary equipment must not exceed the limit values as per EN60 601-1-1:1990 (IEC 60601-1-1) resp. other valid national or international standards.**
All equipment must comply with UL, CSA and IEC requirements.

CAUTION ! **Auxiliary equipment must only be connected to the main console with the special mains outlet provided for the electrical safety of the system.**

CAUTION ! **Auxiliary equipment with direct mains connection requires galvanic separation of the signal and / or control leads.**

CAUTION: **The outlets ST1 – ST5 may be set to 230V or 115V**
Modification of voltage setting only by an authorized service person!

ATTENTION ! **With the color video monitor connected to its isolated mains outlet, the remaining load capacity for auxiliary equipment is max. 350 VA.**

WARNING ! **Only accessories explicitly recognized by the system manufacturer GE Medical Systems Kretztechnik GmbH & Co OHG may be used in connection with the system.**

This page intentionally left blank.

7. Technical Data/Information 7-2
7.1 Power Supply 7-3
7.2 Transmitter 7-4
7.3 Receiver 7-4
7.4 Scan Converter 7-5
7.5 Cine Loop Memory 7-5
7.6 Display Modes 7-5
7.7 Signal Processing 7-6
7.8 Data Entry 7-6
7.9 Measurement and Calculation Programs 7-6
7.10 User Program Memory 7-7
7.11 Volume Scan Module 7-8
7.12 Spectral Doppler 7-9
7.13 Color Doppler 7-10
7.14 Tissue Doppler 7-11
7.15 Power Doppler 7-11
7.16 Interfaces 7-12
7.17 Monitor 7-13
7.18 External Drives 7-13
7.19 MAN ECG preamplifier 7-14

7. Technical Data/Information

TYPE: VOLUSON® 730
MODEL: VOLUSON® 730

SERIAL NUMBER

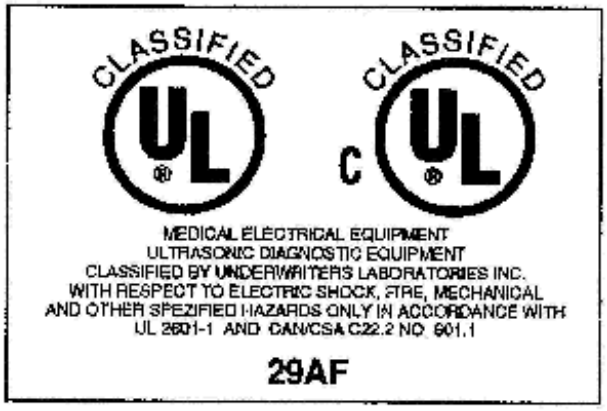
Position: Rear side of the Unit in the identification plate.

Identification plate

Example:

Kretz KRETZTECHNIK A4871 ZIPF		
Type VOLUSON 730		Nr. A0*
manufactured: **		
Protection Class I		
230V~	1010 VA	50/60Hz
MADE IN AUSTRIA		

UL Classification Label



7.1 Power Supply

Power requirements: 230V AC
100 V, 115V, 130V,
230V, 240V AC in compliance with UL 2601 when operated with center tapped mains supply.
50 Hz, 60 Hz (± 2%)

Power consumption: nominal 1010VA
including all options
typical power consumption with 350VA load ST1 - ST5 approx. 4A at 230V/50 Hz

Perceived noise level: max. 57 dB/A

Mains outlets: Mains socket ST1, ST2, ST3, ST4, ST5 for accessories.
All mains outlets are co-switched by the unit's mains switch via built-in isolation transformer.
Output voltage for: ST1- ST5: 115V or 230V
Modification of voltage setting only by an authorized service person!

Output power: 350VA per mains outlet, max. power of all connected accessories must not exceed 350VA.

EMC (Electro-Magnetic Compatibility): EN 60601-1-2:1994

Emission: EN55011 Group 1 Class A
EN61000-3-2 Power line harmonics

Immunity: EN61000-4-2 (IEC1000-4-2): 2,4,8kV air discharge,
2,3,4kV contact discharge
EN61000-4-3 (IEC1000-4-3): 26- 1000 MHz 3V/m
EN61000-4-4 (IEC1000-4-4): 2kV burst on power lines
EN61000-4-4 (IEC1000-4-4): 1kV burst on data lines
EN61000-4-5 (IEC1000-4-5): 2kV differential mode
1kV common mode
EN61000-4-6 (IEC1000-4-6):
150 kHz-80 MHz, 3V (80% AM, 1kHz)
except area of effective frequency (1-16 MHz)

Electric safety: EN60601-1 (IEC60601-1)
Mechanical safety: EN60601-1 (IEC60601-1)
Thermal safety: EN60601-1 (IEC60601-1)

Electro-magnetic influence: In the working frequency range of the ultrasound system from 1 to 16 MHz an influence on the ultrasound image can be visible in the range from 200...500mV/m depending on the probe connected.

Duty cycle: 100% on
Surge current limiter: built-in
Safety classification: Class I, applied parts type BF acc. to EN60601-1/1990 (IEC 60601-1/1990)

Ambient temperature:	10°C to 40°C resp. 50°F to 104°F (operation temp. of instrument) -10°C to 40°C resp. 14°F to 104°F (stock and transport temp.) working temp. of probes see probe user's manual
Barometric pressure:	700 to 1060 hPa (operation condition) 700 to 1060 hPa (stock and transport condition)
Humidity:	30 to. 80% RH no condensation (operation condition) 0 to. 90% RH no condensation (stock and transport condition)
Humidity protection:	covered, no humidity protection
Over-temperature protection:	yes, provided by three fans
Dimensions:	680 x 1000 x 1450 mm [width x depth x height] 26.7 x 39.4 x 56.1 in.
Weight:	basic unit (without accessories) approx. 136 kg

7.2 Transmitter

Frequency range:	Broad band system 1 to 16 MHz, automated adaptation to the probe used.
Control of acoustic output:	Range: 32 dB, adjustable in 1dB steps
Focusing:	selectable transmit focal length and focal depth
Processing-channels:	512 channels
Sound field parameters:	the declaration of the sound field parameters acc. to IEC1157 can be furnished by the manufacturer on request. Sound field limiting parameters on request.

7.3 Receiver

Frequency range: Broad band system 1 to 16 MHz, automated adaptation to the probe used.

Focusing (with annular and multi-element):	Sub-pixel based digital dynamic focusing system: Accuracy of focus: +/- 3ns Sample-rate: 60.0 MHz
Processing-channels:	High resolution Mode: 512 channels
Receive-apodization:	yes
TGC:	manual, 100 dB control range by gain knob and slider-pots
Dynamic range:	150dB

7.4 Scan Converter

Video memory size:	800 x 600 x 32 bit
Image memory:	4 MB
Gray scale values:	256 (8 bit)
Depth range:	depends on used probe
Image lines:	max. 1024
Scan angle:	max. 360°
Aspect ratio:	min. 0.25:1 to max. 8:1 (Write 5:1, Read factor 0.8 to 2.4), incremental magnification, no loss of resolution.
M-Mode:	M-Mode search line positionable at each scan line
M-Mode depth range:	same as B-Image
M-Mode full screen scroll time:	300 / 225 / 150 / 100 Pixels/sec. (50 Hz) in relation to monitor width 3.5 / 5.0 / 7.5 / 10 cm/s
2D/M-Mode simultaneous:	yes (multi-element probes)

7.5 Cine Loop Memory

Capacity:	up to 256MB typ. 3000 2D-images
Call-up of sequence:	manual image by image automated: 50 to 100% of real-time rate, liberal selection of start- and end image

7.6 Display Modes

2D-scan:	Single, Dual, Quad, Trapezoid-Mode, Focus and Frequency Composite (FFC), Compound Resolution Imaging (CRI), Harmonic Imaging, β-View (Beta View)
2D-volume scan:	Volume Contrast Imaging (VCI)
3D-scan:	Multiplanar analysis, Volume scan
4D-scan:	Real-time 4D, Real Time 4D Biopsy
M-Mode:	2D/M
Doppler-Mode:	2D/D horizontal Partition, three different formats 40/60, 50/50 and 60/40
Color Doppler Mode:	2D/CFM (Single, Dual, Quad), 2D/CFM/D, 2D+2D/C
Image orientation:	left/right and up/down selectable

7.7 Signal Processing

Persistence filter:	8 steps (pre)
Line filter:	3 steps (pre) off , low (12,5/75/12,5%) , high (25/50/25%)
Enhance:	6 steps (pre) 0 , 1 , 2 , 3 , 4, 5
Reject:	51 steps (pre) from 0 to 255
Gray scale dynamic:	9 basic curves and 3 User-defined (pre, post)
Dynamic:	12 different dynamic curves C1 - C12
Quality:	3 steps (pre) low , norm , high

7.8 Data Entry

Patient data:	1 line with 32 characters
Clinic/Doctor's name:	1 line with 32 characters
Auto Text memory:	40 user-programmable terms with 10 characters each.

7.9 Measurement and Calculation Programs

Basic Measurements:

Distance:	2D Mode: Distance, Trace, Hip Joint M Mode: Distance, Time, Velocity D Mode: Acceleration Velocity + Pressure Gradient, Velocity Ratio, Average Velocity
Area:	Contour (Trace), Ellipse-Mode
Volume:	1 Distance, 1 Ellipse, 3 Distance, 1 Distance + Ellipse 3D MultiPlane (planimetric volume)

Obstetric Calculations: Fetal Weight (FW) estimation, Biophysical Profile, Growth Analysis Graphs and Data Memory for all measurement values.

Fetal Biometry:	AC, APAD, APTD, BPD, CRL, FL, FTA, GS, HC, OFD, TAD, TTD and YS
Early Gestation:	BPD, CRL, GS and FL
Fetal Long Bones:	Humerus, Ulna, Tibia, Radius, Fibula, Clavicle and Length of Vertebra
Fetal Cranium:	Cerebellum, OOD, IOD, HSVa, HSVp, HEM, CM
Uterus:	Length, Height, Width, Endo. Thickness and Cervix Length
Fetal Doppler:	Umbilical Artery, Lt./Rt. Uterine Artery, MCA, Lt./Rt. Fetal Carotid, Fetal Aorta, Ductus Venosus, Fetal Heart Rate (PSV, EDV, RI, Gpeak, Gmean)

	Others:	AFI (Amniotic Fluid Index), NT (Nuchal Translucency), BOD, Ear, Foot, CI (Cephalic Index), different Ratios, etc.
Gynecology Calculations:	2D Mode:	Uterus, Lt./Rt. Ovary, Lt./Rt. Kidney, Lt./Rt. Follicles
	D Mode:	Lt./Rt. Ovarian Artery, Fetal Heart Rate
Cardiology Calculations:	2D Mode:	Simpson, Vol A/L (Area Length), LV-Mass, 2D Measurements (LV EF 2D Protocol), LVOT Diameter and RVOT Diameter
	M Mode:	LV (Left Ventricle), Ao/LA (Aorta/Left Atrium), MV (Mitral Valve) and HR (Heart Rate).
	2D Mode:	MV (Mitral Valve), R-R Interval, AoV (Aortic Valve), TV (Tricuspid Valve), PV (Pulmonary Valve), LVOT-Doppler (Left Ventricle Outflow Tract), RVOT-Doppler (Right Ventricle Outflow Tract), Pulmonic Veins, HR (Heart Rate) and PAP(Pulmonary Artery Pressure measurement)
	CFM Mode:	PISA-Radius and PISA-Alias Velocity
	Additional evaluation values:	Diast. Vol.(Bi), Syst.Vol.(Bi), Stroke Volume, Cardiac Output, Eject. Fraction, Fract. Shortening FS, Myocardial Thickness, LA/Ao, Ratio E/A, Peak Gradient, Peak Gradient Acceleration, Mean Gradient, Mean Gradient Acceleration, VTI, TVA, PG, PHT, MVA, AVA, ERO, etc.
Vascular Calculations:	Items:	Lt./Rt. ICA, Lt./Rt. CCA, Lt./Rt. ECA, Lt./Rt. Vertebral Artery, HR and Peripherals
	2D Mode:	Stenosis (%StA, %StD), Vessel Area, Vessel Distance
	M/D Mode:	Heart Rate
	Evaluation values:	PSV, EDV, Peak Gradient, Mean Velocity, RI, S/D, PI, VTI, Stroke Volume, Volume Flow, etc.

7.10 User Program Memory

Program presets:	max.5 applications, each application max. 8 settings max. 40 settings per probe

7.11 Volume Scan Module

Vol. scan size:	64 MB minimum The required memory space depends on scan parameters (VOL-box size and quality (low , mid1 , mid2 , high1 , high2). typ.: 1-5 MB
Lines/2D-image:	max. 1024 (typ. 80 to 350)
2D-images/volume:	max. 1024 (typ. 50 to 250)
VOL-Frames/sec.:	max 16 (typ: 3-6) The frame rate depends on scan parameters (VOL-Box size, quality and probe.

Display of sectional plane images:
synchronous with control setting, arbitrary movement in volume, monitored position in volume.

Rotation: 360°, 0.5° increments (X-, Y- and Z-axis)

Magnification: adjustable from 0.25 to a factor of 4.00

3D-Rendering: Calculation and display of rendered gray scale images:
surface mode, maximum mode, minimum mode;
calculation time depending on rendering box size

Calculation and display of rendered color-images:
3D PD Mode: surface mode, max. intensity mode

Display Modes: 3-section Mode:
A triplet of 3 sectional planes normal to each other is displayed.
Full-sized image:
Display of 1 single full-screen image.
Niche image:
Display of the sectional plane triplets within the (graphics) cube.
4 section mode:
Display of sectional images + calculated 3D images

Display graphics: Color display of the center of rotation and the axes.

Data interface: SCSI (Option) Bi-directional transfer of volume, image data sets between console and mass storage medium.

Data transferred:
volume, image data
date, time
clinic's name / doctor's name
patient data
control settings
No measurements and text data!

7.12 Spectral Doppler

Working Modes:	Pulsed Wave Doppler (Single Gate), PW Continuous Wave Doppler, CW
Transmit frequencies:	PW-Doppler: 1 - 16 MHz CW-Doppler: 2 - 7.5 MHz
Pulse Repetition Frequency (PRF):	1.3 ...22 kHz
Sample Volume (Doppler Gate):	Length: 1, 2.5, 6, 10, 15 mm Position: 5 mm to B-scan end Angle correction: - 85° … 0° ... + 85°
Power control range :	32dB
GAIN range:	- 15 … + 15 dB
WMF (wall motion filter):	0...400 Hz
Zero line shift:	± PRF/2, ± 8 steps
Spectrum Analyzer:	FFT (Fast Fourier Transformation) Max. 512 channels, 255 amplitude levels
Display scroll speeds:	100, 150, 225, 300 SL/s (SL.. spectral lines/sec.)
Review (memory times):	> 60 s
Measurable flow velocities:	
Pulsed wave:	1cm/s.....3m/s (a = 0°, 3.5 MHz, max. zero shift) 1cm/s.....6m/s (a = 60°, 3.5 MHz, max. zero shift)
Continuous wave:	1cm/s...10m/s (a = 0°, 2.25MHz, max. zero shift) 1cm/s...20m/s (a = 60°, 2.25MHz, max. zero shift)
Signal processing:	Reject: 6 steps Dynamic range: 20 to 150 (step size = 5)
Measuring value display:	kHz, cm/s, m/s
Image formats:	D, 2D+D (three different formats 40/60, 50/50 and 60/40)
Simultaneous Mode:	2D/D, 2D/D/CFM and 2D/D/PD
Audio-Modes:	Stereo (both directions separately in both channels)
Audio Volume, balance:	Adjustable, control knobs

7.13 Color Doppler

C-Mode:

Color flow imaging is possible with Curved Array, Linear Array and Phased Array probes.

Display Modes:	2D/CFM (Single, Dual, Quad); 2D+2D/C Simultaneous triplex mode 2D/CFM/D
Color coding steps:	8192 color steps
Depth range:	axial: 0 to B-scan range lateral: 0 to B-scan-range
Zero line shift:	17 steps (independent from spectral Doppler)
Inversion of color direction:	yes
Wall Motion Filter:	7 steps
Smoothing Filter:	12 steps rising time 12 steps falling time
Gain control :	30dB
Density (color line density):	10 steps
Ensemble (color shots per line):	7 to 31
Pulse repetition frequency:	100 Hz to 20.5 kHz
CFM Map:	8 different color codes for each probe
Frequency range:	1 to 15 MHz depending on the probe, adjustable in 3 steps (low, mid, high)
Balance:	from 25 to 225 in 41 steps
Max. meas. velocity:	5.5 m/sec.
Min. meas. velocity:	0.3 cm/sec.
Display Modes:	V-T (velocity + turbulence) V (velocity) V-P (velocity + power) T (turbulence) P-T (power + turbulence)
Scale:	kHz, cm/s, m/s
Automatic moving tissue suppression:	yes

7.14 Tissue Doppler

TD-Mode:

Tissue Mode flow imaging is only possible with Phased Array probes.

Display Modes:	2D/TD (Single, Dual, Quad); 2D+2D/TD
TD coding steps:	8192 color steps
Depth range:	axial: 0 to B-scan range lateral: 0 to B-scan-range
Zero line shift:	17 steps
Inversion of color direction:	yes
Smoothing Filter:	12 steps rising time 12 steps falling time
Gain control :	30dB
Density (color line density):	9 steps
Ensemble (color shots per line):	7 to 31
Pulse repetition frequency:	100 Hz to 13 kHz
TD Map:	4 different color codes for each probe
Frequency range:	1 to 15 MHz depending on the probe, adjustable in 3 steps (low, mid, high)
Balance:	from 25 to 225 in 41 steps
Max. meas. velocity:	5.0 m/sec.
Min. meas. velocity:	0.3 cm/sec.
Display Mode:	V (velocity)
Scale:	kHz, cm/s, m/s

7.15 Power Doppler

PD-Mode:

Power Doppler imaging is possible with Curved Array, Linear Array and Phased Array probes.

Display Modes:	2D/PD (Single, Dual, Quad); 2D+2D/PD Simultaneous triplex mode: 2D/PD/D 3D/PD
PD coding steps:	256 color steps
PD window size:	lateral: maximum to minimum B-Mode scan angle axial: 0 B-scan range
Display Mode:	P (power)
Wall motion Filter:	7 steps
Smoothing Filter:	rising edge: 12 steps falling edge: 12 steps
Gain control:	30dB
PD display ensemble:	7 to 31
PD display density:	10 steps
Pulse repetition frequency:	100 Hz to 20.5kHz
PD Map:	8 different color codes for each probe
Frequency range:	1 to 15 MHz depending on the probe, adjustable in 3 steps (low, mid, high)
Image sequence memory:	max. 128 images, 1024 images optional
Balance:	from 25 to 225 in 41 steps
Artifact suppression:	yes

7.16 Interfaces

Video out	BNC-socket video norm: PAL/NTSC FBAS-signal: $1V_{SS}/75\Omega$		
Video out	BNC-socket video norm: PAL/NTSC or black/white video (whiteout color carrier) CCIR-signal: $1V_{SS}/75\Omega$		
Video in:	BNC-socket video norm: PAL/NTSC FBAS-signal: $1V_{SS}/75\Omega$		
S-Video in/out:	1 x Mini DIN for IN 1 x Mini DIN for OUT video norm: PAL/NTSC		
	Chrominance:	in:	$0.3V_{SS}/75\Omega$
	Luminance:	in:	$1.0V_{SS}/75\Omega$
	Mass:	in:	GND
	Chrominance:	out:	$0.3V_{SS}/75\Omega$
	Luminance:	out:	$1.0V_{SS}/75\Omega$
	Mass:	out:	GND
RGB out:	BNC -sockets		
	Red:		$0.7V_{SS}/75\Omega$
	Green:		$0.7V_{SS}/75\Omega$
	Blue:		$0.7V_{SS}/75\Omega$
	Composite H/V-Sync:		TTL-CMOS
	Mass:		GND
VGA out:	Red:		$0.7V_{SS}/75\Omega$
	Green:		$0.7V_{SS}/75\Omega$
	Blue:		$0.7V_{SS}/75\Omega$
	Separate positive H/V-Sync: TTL-label		
Audio in L:	Cinch, LF-signal $1.2V_{SS}$		
Audio in R:	Cinch, LF-signal $1.2V_{SS}$		
Audio out L:	Cinch, LF-signal $1.2V_{SS}$		
Audio out R:	Cinch, LF-signal $1.2V_{SS}$		
Footswitch in:	BNC-socket: FREEZE/RUN Freeze/Run in: TTL-CMOS, active low		
Remote control out:	BNC-socket: PRINT A DIN-socket: PRINT B Remote signal: TTL-CMOS, active low, Imax = 25 mA RS232: VTR remote control		
Net connection:	Ethernet, IEC802-2, IEC802-3 Software: DICOM 3.0 standard		

7.17 Monitor

SVGA Monitor :	Type: Sony PGM -100 P1MD
Monitor resolution:	1280x1024 pixel (800x600 internally used)
Scanning frequency:	Horizontal: 30 to 65kHz
	Vertical: 50 to 120Hz
Nominal current:	100-120V 50/60 Hz 1.8A
	220-240V 50/60 Hz 1.0A
Safety classification:	Class I, Type B
	Standards: EN60601-1 (IEC60601-1)
	UL listed or classified
Mains switch:	2-pole single throw

Picture tube: 15" intrinsic-safe cathode ray tube acc. to annex III German X-Ray Regulation

7.18 External Drives

Magneto-Optical Drive 3 ½ ":

Storage capacity:	128MB, 230MB, 540MB, 640MB, 1.3GB
Power requirements:	5VDC ± 5% : 1.2A (avg.) ;2.5A (max).
Ambient temperature:	
Operating:	5°C - 45°C
Non-operating:	0°C - 50°C
Relative humidity:	10-85% (non-condensing)

Re-writeable Magneto Optical Disc 3 ½ ":

Storage capacity:	128MB, 230MB, 540MB, 640MB, 1.3GB
Ambient temperature:	
Operating:	5°C - 55°C, 3-85 %RH
Storage:	-10°C - 55°C, 3-90 %RH
Archival life time:	min. 30 years

CD-RW drive:

Re-Write Speed:	Read 24x, Write 8x, Re-Write 8x
Access Speed:	140ms
Max Data Transfer (Read):	3600KB/sec
Buffer Size:	4MB
Archival life time:	min. 30 years

7.19 MAN ECG preamplifier

Input	Floating input
Patient cable	Push-button electrode connections, 3-leads, KENDALL medizinische Erzeugnisse, Code 8/P93/07-01, Ref 3227.0701.00)
Input voltage	±1mV (diff.)
Frequency range	0.1 - 150Hz
Rejection filter	50 and 60Hz
Distribution voltages	15V provided via special connection (may be installed by authorized personal only)
Ambient temperature	+10°C (50°F) to +40°C (104°F)
Storage and transport temperature	-10°C (14°F) to +40°C (104°F)
Dimensions (L/W/H)	220/150/40 mm
Safety tests	acc. to IEC 60601-1: 1988 + A1: 1991 + A2: 1995

Symbols used:

Insulated patient application part acc. to EN60 601-1(Type BF)

CAUTION! Review user manual for proper operation!
(Improper use may cause damage.)

ECG Symbol